Design Engineering

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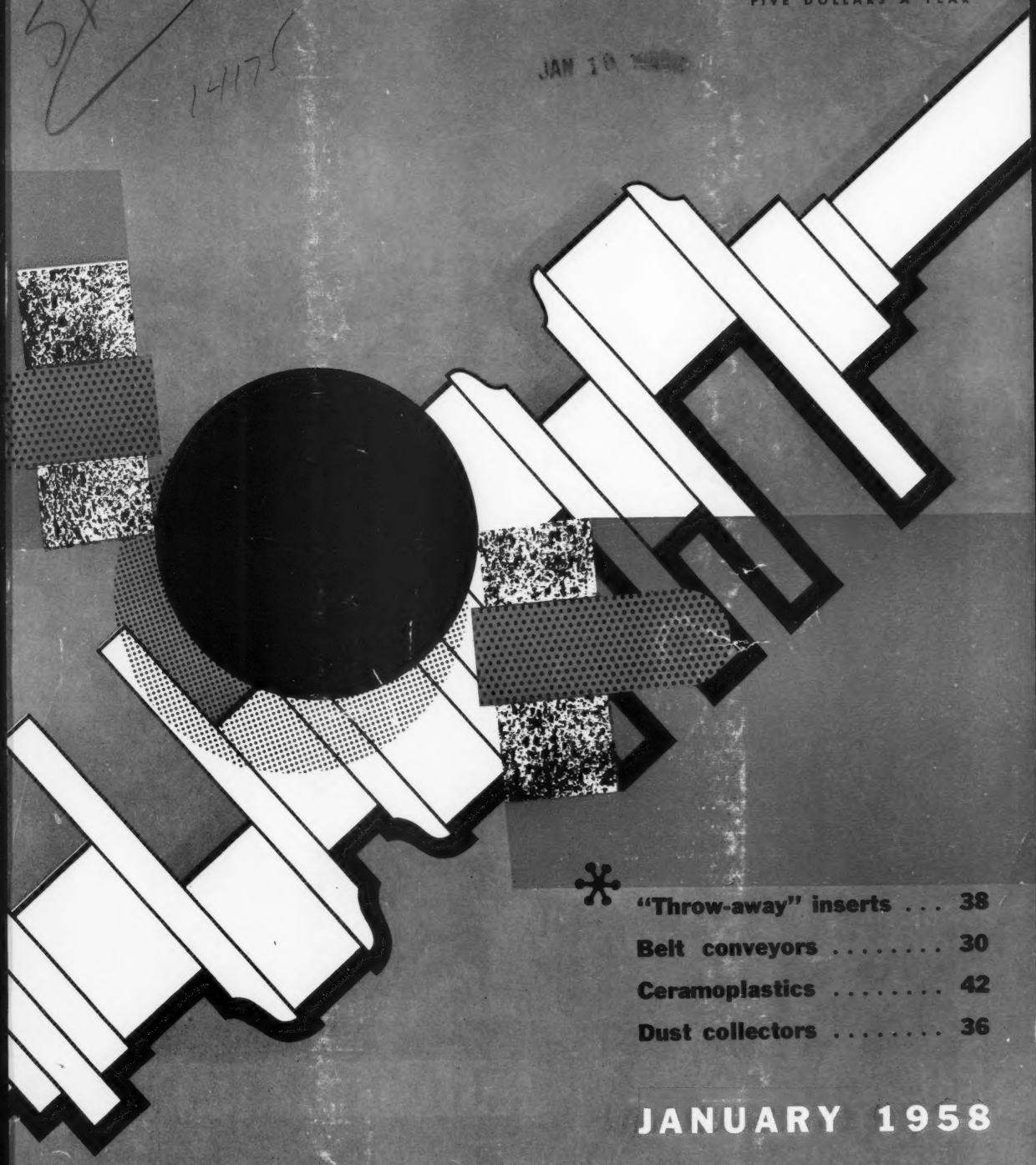

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JANUARY 1958

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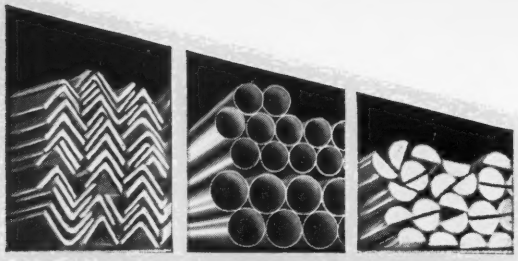

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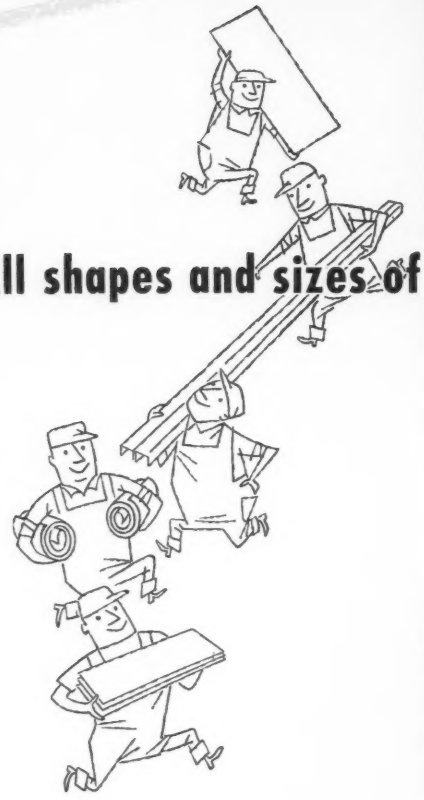

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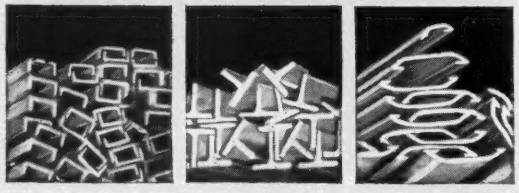

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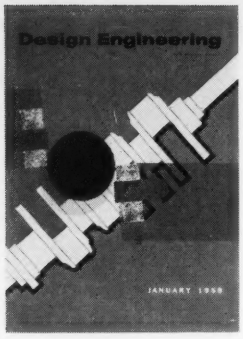

This month's cover

Boldly stretching in a diagonal line across the cover is a readily recognizable crankshaft. The rest of the cover pattern may need some explanation. The large black circle represents the same shaft in section and turns between two rectangles of darker brown, tipped with black and white flecks. The flecked parts are the "throw-away" inserts now gaining acceptance in machining. The January issue has an article on these inserts. Gerald Bern was the artist.

Design Engineering

MEMBER

CCAB

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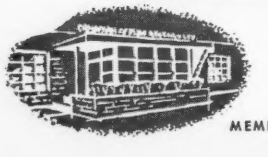

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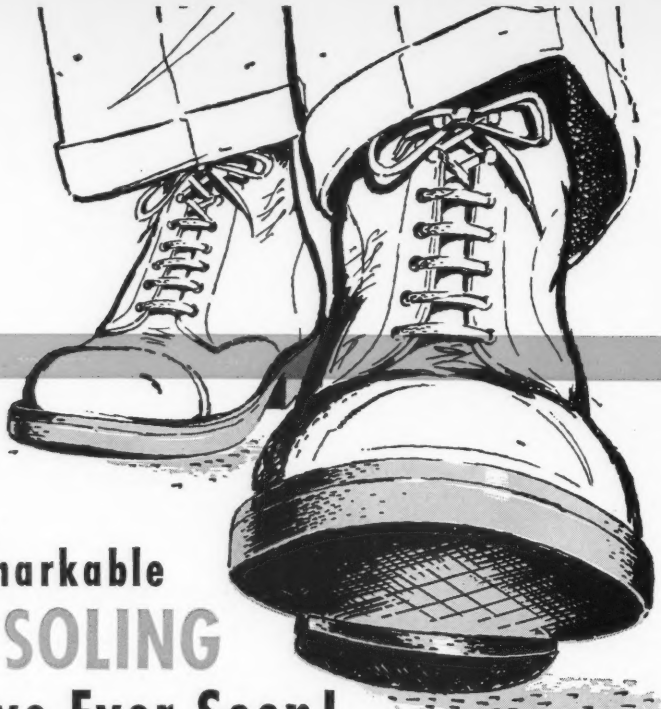
Design Engineering

Inside

J. Harry DuBois, author of this issue's article on ceramoplastics, is vice - president, engineering, of the Mycalex Corporation of America. No stranger to seeing his work on the printed page, DuBois has authored, co-authored and edited numerous technical writings. Educated at the University of Minnesota, where he took a B.S. in electrical and mechanical engineering, he has a wealth of plastics experience gained with GE, the Shaw Insulator Company and Plax Corporation.

G. G. M. Carr-Harris, P.Eng., wrote the lead article on marine propellers. Born in Kingston, he received early education at RMC where, for 13 years, he taught engineering as a member of the academic (civil) staff. Mr. Carr-Harris has a distinguished record of service in both world wars. He attended Cambridge University and the Military College of Science in England and studied railway operation with the Southern Railway there. He has a Master's degree in mechanical engineering from Cornell University.

D. M. Duncan (author of the dust collector article) served his apprenticeship as a marine engineer and graduated with a B.Sc. in mechanical engineering from Glasgow University. For two years he was technical editor of Canadian Machinery and Manufacturing News. He spent 15 years with Hespeler Engineering Co. and F. F. Barber Machinery Co. and, for the past 13 years has been president of the D. M. Duncan Machinery Co. Ltd. (machine tools).



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REPORTS ★

A news roundup of items of engineering and design interest from the world over

The mournful dirge of the diesel men

★ Few fields are more competitive at this moment than the diesel engine. This gets emphasis from "London Letter" happily crowing the success of the British firm of F. Perkins in landing a fat contract from a German manufacturer of self-propelled combines. Truly a triumph in the teeth of competition.

Robin Berens from Perkins' Toronto office confirmed this. "We are all hoping to find more customers in Canada," he said, "but sales would be considerably higher if it hadn't been for the recent tax slapped on diesel fuel in Ontario."

Fred Livingston of Russel-Hipwell Engines Ltd. (the Cummins distributors) was even more outspoken on the tax. "As soon as that (the tax) hit we had a lot of cancellations," confesses Livingston, "and, of course, nobody wanting to buy new equipment. The tax went up from 11c to 13c a gallon on gasoline and from 11c to 20c on diesel fuel — out of all proportion."

A fast survey of the diesel field shows a bunch of men still hopping mad about the tax (now almost a year old) and still working hard to get it repealed.

You can squeeze yourself a corned beef on rye

★ A jet pilot, like the rest of us, must eat. When such a man is all tricked out in his pressure suit finery, escape kit, helmet, and the rest of an airman's rig, this everyday pleasure becomes a task bristling with difficulties.

Now, however, there's hope for the hungry birdman in the news that U. S. scientists are developing "food tubes." Menus fit for a dinner at Maxim's may be dispensed through the face mask from something like a toothpaste tube or, in stick form from a device like a woman's lipstick dispenser—twist the end and your lunch advances along the tube toward the mouth.

Yet another idea, but one that precludes aerobatics, is meats in the consistency of a chocolate malted that are allowed to run through a tube into the pilot's mouth from a can held overhead.

Wanted: an elusive material. Can you help?

★ We are looking for a material which must have these properties; it must not deform at temperatures up to 350 F, be resistant to calcium chloride and to chromic and sulphuric acids in diluted form. Porcelain, which fits the requirements, is ruled out on the score that it fractures too easily.

Any readers with possible solutions will be doing the editors a favor by passing their ideas along to Design Engineering.

What happened? Where did our inventors go?

★ The Commissioner of Patents tells us that, of the 15,513 patents issued in Canada in the year ended March, 1957, a paltry 4.9% went to Canadians.

Biggest chunk of patents was snapped up by investors south of the border who took 71.1%. European countries took 12.1% and the U. K. 10.5%—all well ahead of our home-grown inventors.

. . . maybe there's new life for them here

★ No sooner had the item on Canada's inventor-starved situation been typed than Design Engineering received wind of a new project designed to give homegrown inventors a boost.

Prime mover in the scheme is a 41-year-old Dane, Poul Baumann, a Canadian resident since 1951.

"I am an inventor myself," he told us, "and although I've made quite a bit of money from my inventions, I've had a thousand headaches at the same time. Canada has been good to me and I think I can make a repayment by letting her inventors benefit from my experience. Furthermore, I believe there will be considerable unemployment this winter and manufacturers will be looking for good new ideas. I hope to bring the manufacturers and idea-men together so both can benefit."

A medal is struck for the mechanical engineer

★ This magazine recently received the news from EIC that a medal had been created "to perpetuate the memory of Robt. W. Angus, Hon. MEIC" who was first professor of mechanical engineering at the University of Toronto way back at the turn of the century.

The phrasing might mislead a skimming reader into thinking the award was named after a leading figure in Canadian mechanical engineering, now dead. Professor Angus, on the contrary, is very much alive and a spry 84.

Speaking to Design Engineering he recalled earlier days at U of T. "When I graduated in 1896, mechanical engineering was just part of an engineering course. I was given the responsibility of making it a separate department, became its lecturer in 1900 and its first professor six years later."

With a span of experience as long as that of Professor Angus, had there been many changes in U of T's engineering department? There certainly had. "Its growth has been unbelievable," mused Angus, "during the first World War, for instance, I doubt if I had more than two or three students in the graduating year."

An example of industry giving education a hand

★ An impressive total of $52,000 has been awarded by Union Carbide for scholarships and fellowships this academic year. The cash, spread over 68 students, will go as $500 scholarships to 60 of them, and as $1,500 research fellowships to the remainder. Out of the total, a gratifying 44 are studying engineering and science.

To see industry at work in education, Design Engineering asked a man who had received a research fellowship how he was using his grant.

Mike Plummer, England-born, South African raised and educated, has been in Canada almost five years. "After a four-year Air Force stint during the war," says Plummer, "I went to Pretoria University and took physics and chemistry. On graduation I had a job as an analytical chemist in Northern Rhodesia until a muddy political situation there and the hope of greater opportunity in the New World drew me to Canada."

Plummer married an Australian girl and took a job for two years up in Sudbury where his first child was born. He now has a second, born in Toronto. Needless to relate, he has kind words to say about Union Carbide. "I was very happy with it (the grant)," says he, "and lucky to get a substantial one."

The ASM has a big meeting coming up in February

★ The American Society for Metals holds its "Presidents' Night" at the Prince George Hotel in Toronto on February 7. Speaker at that meeting will be G. M. Young, Technical Director for the Aluminum Co. of Canada and ASM's National president.

New trends and developments in designing electrical products...

• How complex permanent-magnet assemblies are built to desired field patterns from simple magnet shapes

G-E permanent magnets provide unlimited design flexibility

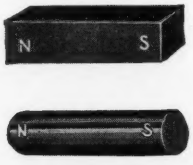
The fundamental problem in designing with permanent magnets is how to provide a specific magnetic flux in a desired field pattern.

In solving this problem, a designer can choose from seven General Electric Alnico grades, hundreds of styles, weights from a fraction of an ounce to a hundred pounds. He can use magnets with two poles – or many poles; with poles at the ends – or anywhere along the magnetic axis.

This all gives tremendous flexibility to the design of permanent magnets and magnet assemblies. But precisely because there are so many sizes, shapes, strengths, and other factors to be considered, this flexibility can make the designer's job far more complicated.

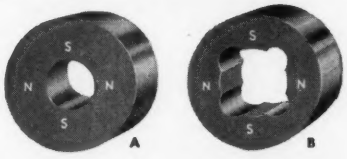
So, to help give a clearer understanding of what can and cannot be done with G-E Alnico permanent magnets, we have prepared this description of basic magnet shapes.

The simplest forms of a permanent magnet are the bar and rod. They are normally salient (i.e., the poles occur at the ends), and may be of any cross-sectional area.



U- and C-shaped magnets are simply bars "bent" to bring both poles to the same plane.

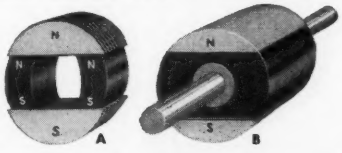
Carry the bending process to its ultimate conclusion and you have the cylinder (see top of next column) with or without the hole. A cylindrical magnet can be magnetized with as many poles as desired on the outside diameter (A), or the inside diameter (B). Not only can the size and shape of the hole be varied, but the magnet can be made salient (B), or nonsalient (A).



All other forms are merely variations on the original themes, even to such nonstandard shapes as these:

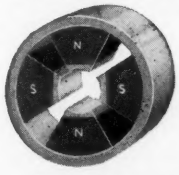
Use of pole pieces adds to design possibilities

One basic use of pole pieces is to provide a return path for the magnetic flux. Pole pieces may be solid (B), or laminated, like this generator magnet (A).



Designers can easily assemble pole pieces and properly shaped permanent magnets to obtain their required field patterns.

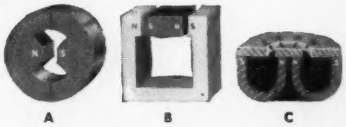
One version is this stator assembly, designed to provide inner poles. The



design can be altered in various ways, depending on mechanical, space, magnetic, or physical properties required.

For example, here is another 4-pole magnet using soft steel. It is also possible to construct an assembly with as many poles as required—by using a number of bar magnets or by using one 2-pole magnet.

Perhaps the most important consideration in the design of magnetic assemblies is the amount of flux across the air gap. These air gaps may be single (A), double (B), or annular (C).



Soft-steel pole pieces are often used to complete the magnetic circuit, allowing maximum flux density though the air gap, with a minimum amount of permanent-magnet material. However, there are a considerable number of variations possible, either with or without pole pieces.

Our G-E magnet engineers have broad knowledge and experience in the design and construction of permanent magnets, pole pieces, and air gaps. They will be more than happy to share their knowledge with you. There is no obligation, and all information is held in strictest confidence. A letter to us will get them to work on your problem immediately.

For engineering assistance or technical literature giving complete data on design and properties of permanent magnets, write to: Permanent Magnet Sales, Canadian General Electric Co. Ltd., 940 Lansdowne Ave., Toronto 4, Ontario.

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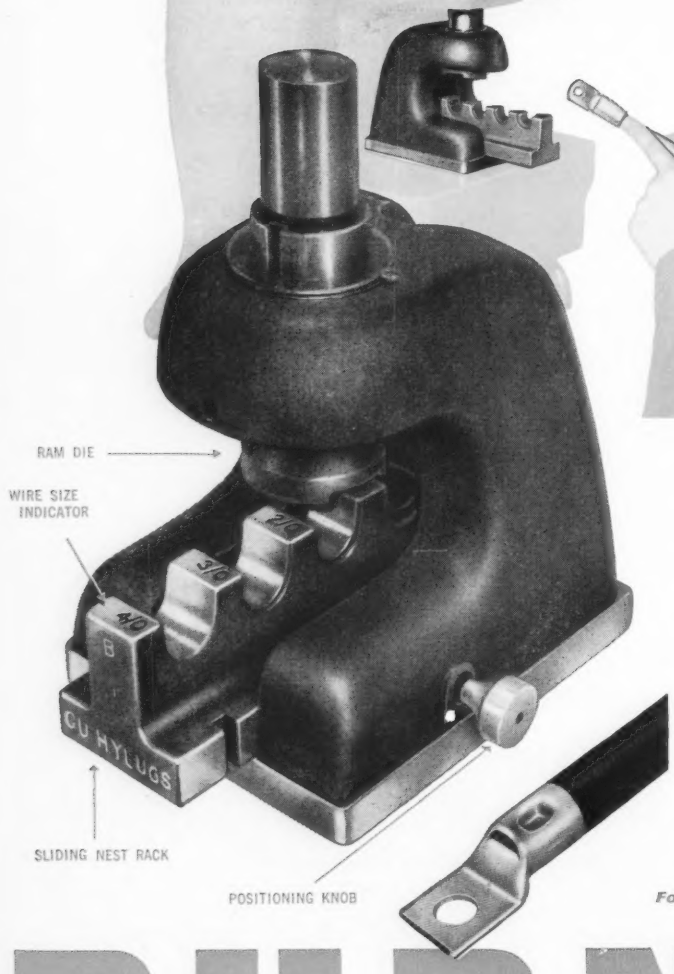

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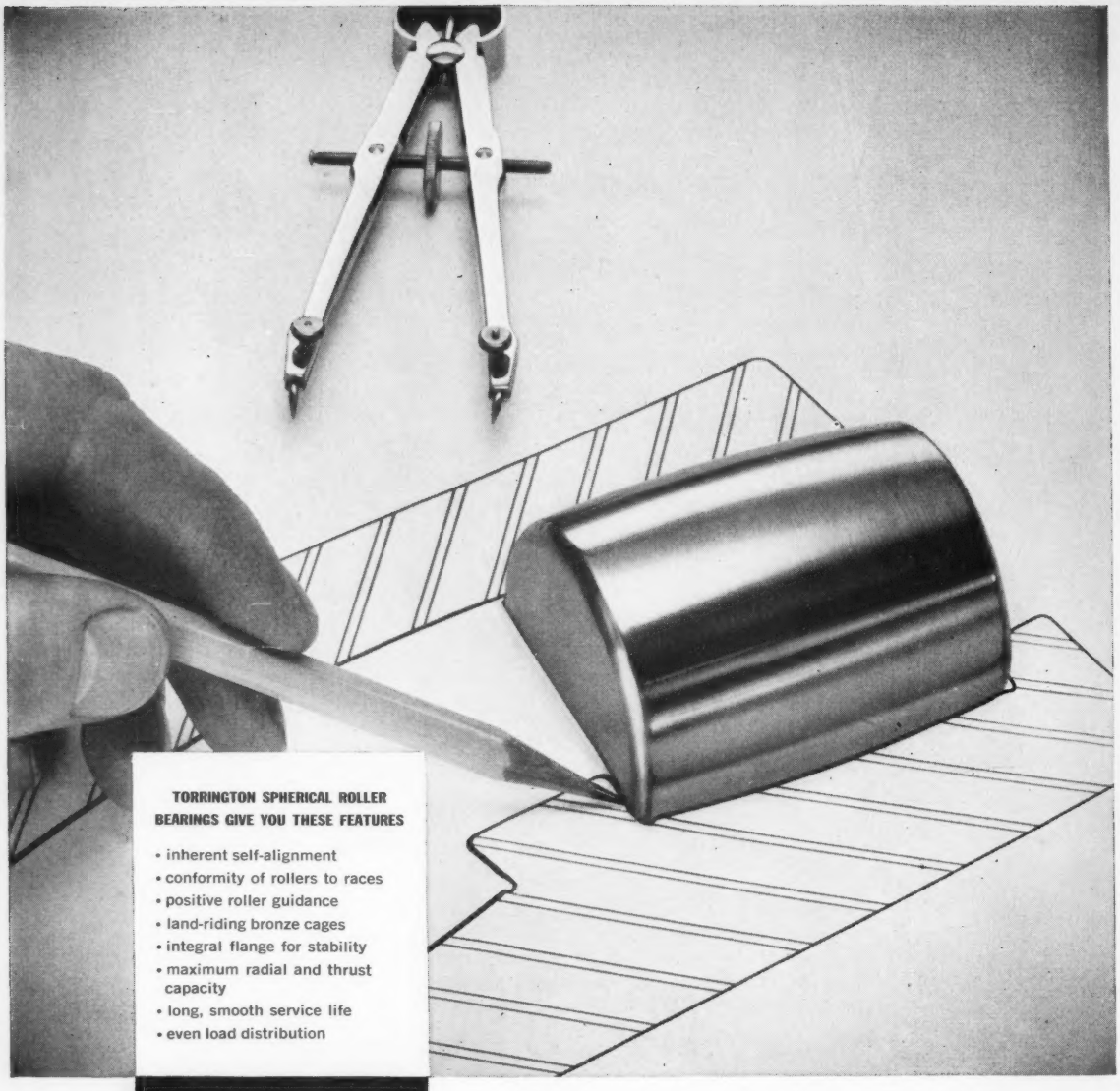

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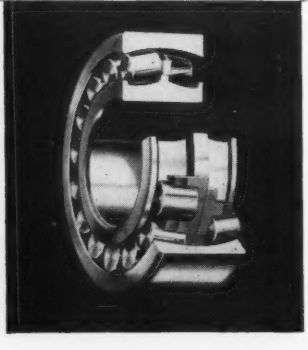

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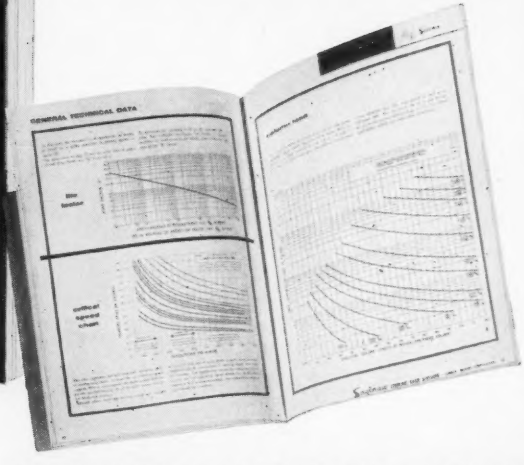

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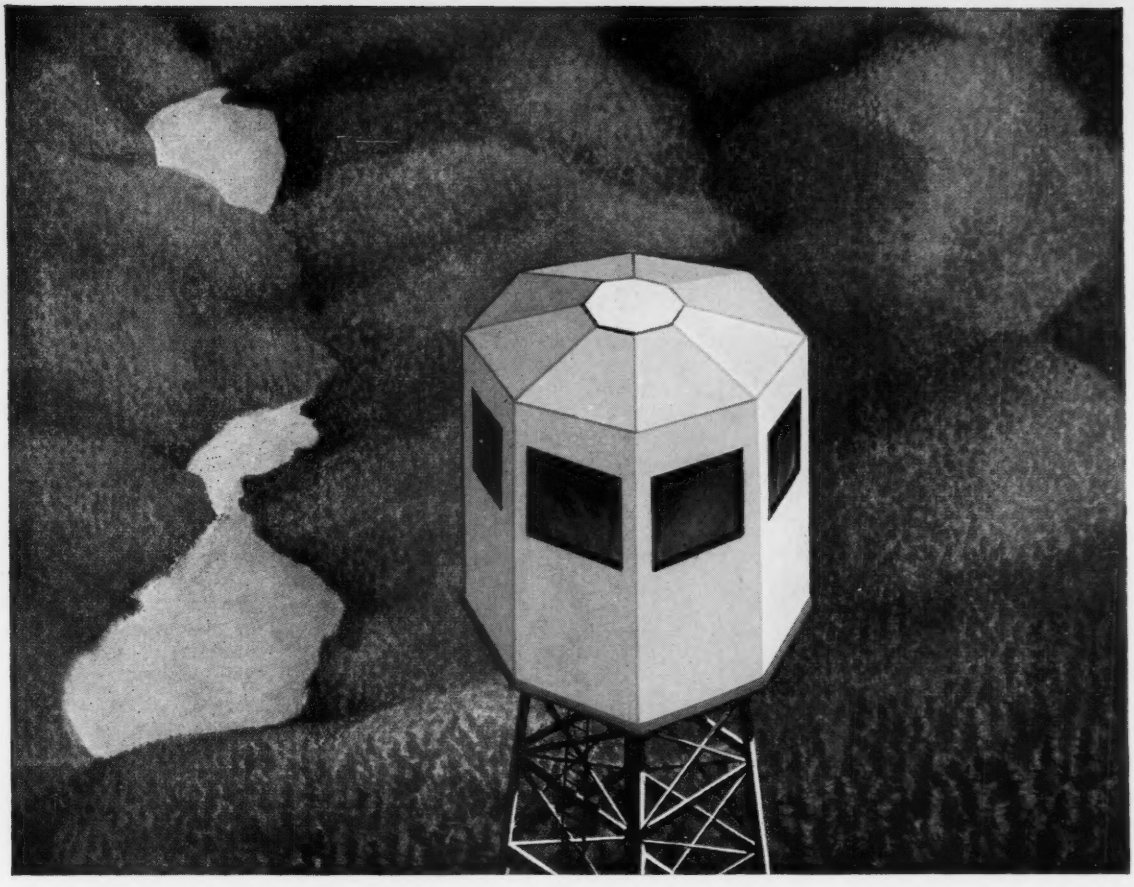

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STYRON 480 — super high-impact formulation with excellent heat resistance. Ideal for uses such as lawn mower wheels, pump impellers and fittings for pipes.

***TYRIL**

A new name in plastics based on styrene and acrylonitrile. Tyril offers unequalled characteristics and balance of properties: high tensile strength, superior toughness, crystal clarity, good heat resistance, outstanding moldability, high chemical resistance and excellent aging characteristics. It's a natural for use in refrigerators, tumblers, houseware goods and numerous other products.

***ETHOCEL**

One of the first plastics, combining light weight and exceptional toughness. Resists many chemicals over a wide range of temperatures. One of its formulations is self lubricating for such applications as roller wheels and oil-less gears.

* Trade marks of Dow Chemical of Canada, Limited

Most often, getting the right plastic for a specific use depends on two things: (1) a broad range of plastics from which to select the exact properties needed and (2) adequate back-up service from the manufacturer. From Dow you get both!

A pioneer in thermoplastics development and production, Dow, today, is the leader in this field. And as such, Dow maintains extensive laboratories in Sarnia where the toughest problems meet research scientists, technicians and engineers. Many of these experts have grown with the industry from its beginning. Their experience — plus the talents of production, styling, colour and marketing service — combine to give you unequalled support in selecting, fabricating, forming and selling plastic products.

Papers, technical bulletins and brochures covering every detail of plastics applications, methods and equipment have been written and kept up to date. This literature as well as personal attention is yours for the asking. Contact our nearest sales office, or write direct to: DOW CHEMICAL OF CANADA, LIMITED, 600 University Avenue, Toronto 2, Ontario.

DOW CHEMICALS

Chemicals Basic to Canadian Living

DOW CHEMICAL OF CANADA, LIMITED • TORONTO • MONTREAL • WINNIPEG • CALGARY • SARNIA

Giant "Merry-Go-Round" for Casting Sands

One of the reasons why C.S.I. can produce quality sand castings so economically, is because they use the same sand again and again.

The equipment that makes this possible is the Sand Handling Plant shown above. This plant, manufactured by the National Machinery Co. in the United States, is 120 feet long and nearly 14 feet high. It has two 18-inch belts that feed 8 hoppers.

When a batch of castings has become cool enough, the moulds are broken open and the castings proceed to the various testing and finishing departments.

The sand is reclaimed. The moulds are crushed and screened and the sand is reloaded onto the belt of the sand handling plant. The plant automatically adds moisture, converting the dry sand to green sand—the precise amount of moisture to be added is determined by laboratory tests. The green sand is then delivered once again by belt and hopper to the moulding machines, to be made into moulds for yet another batch of castings.

This cost-saving "Merry-Go-Round" process is just one aspect of C.S.I.'s modern production methods.

C.S.I. have the equipment, the facilities and the men to produce quality castings at highly competitive prices. For free, informative booklet, write Department A-11

LIGHT METALS CASTING DIVISION

CANADIAN STEEL IMPROVEMENT LIMITED

289 HORNER AVENUE, ETOBICOKE, ONTARIO

Represented in the United States ONLY by—C. F. RUSSELL COMPANY, INC., Bay Shore, New York

Forgings in Steel, Aluminum, High Temperature Alloys, Titanium • Castings in Aluminum and Magnesium

CSI

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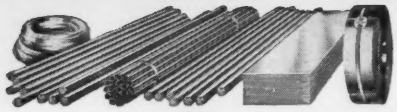
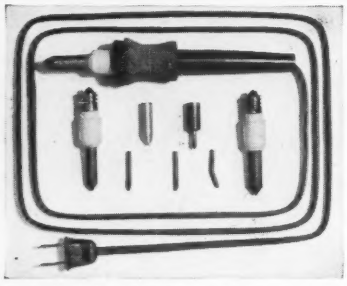


NORANDA COPPER AND BRASS LIMITED

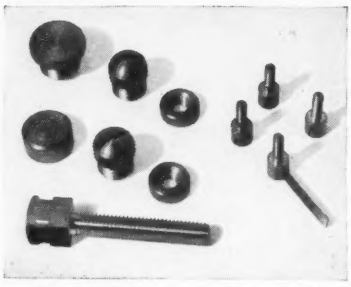
COPPER ALLOY BULLETIN

COPPER AND Noranda BRASS LTD.

MILLS AT MONTREAL EAST—OFFICES IN MONTREAL, TORONTO, WINDSOR, EDMONTON, VANCOUVER
Export Department, P. O. Box 1238 Place D'Armes, Montreal, P. Q., Canada



New lightweight soldering pencil uses Noranda Tellurium Copper tips for easier machining, faster and more uniform heating. (Courtesy, Ungar Electric Tool Co. of Canada, Toronto)



Noranda Tellurium Copper gives machining qualities of free-cutting brass, performance of pure copper to these screw-machined parts.

Noranda Tellurium Copper Offers High Conductivity Plus Machinability

Copper made the practical use of electricity possible. It has always been specified by engineers for the manufacture of components for the electrical industry. New applications are still being found to make use of copper's high electrical and thermal conductivity.

Noranda's research facilities are engaged in a constant search for new materials to satisfy the demands of Canada's expanding industries. For instance, manufacturers of electrical components have been looking for a material that combines the conductivity of copper with the machinability of free-cutting brass. In the past, attempts at alloying copper with various elements have produced a harder material without reducing its characteristic toughness.

In Noranda Tellurium Copper we feel we have the answer. Our engineers have found that the addition of a very small amount of Tellurium to copper raises its machinability from 20% of free-cutting brass to 90%. This is accomplished with negligible effect on its other desired properties.

Using Noranda Tellurium Copper, manufacturers of electrical components can increase screw-machine surface speeds up to four times faster than those recommended for pure copper. Tooling required to work Noranda Tellurium Copper is the same as that used on free-cutting brass.

Noranda Tellurium Copper may be extensively hot forged and, although its ductility is slightly lower than that of pure copper, it can be readily cold worked. All these advantages are gained with electrical and thermal conductivities remaining almost as high as those of pure copper.

Applications

Ungar Electric Tool Co. of Canada, Toronto, uses Noranda Tellurium Copper for tips for their versatile, lightweight electrical soldering pencil for hobby and production line work. A number of interchangeable tips of different sizes and shapes are made from 1/8", 5/16", and 3/8" round Noranda Tellurium Copper rod. Complicated drilling and tapping operations take full advantage of its excellent machinability.

Noranda Tellurium Copper was chosen for other reasons, too. Its high thermal conductivity gives uniform heat at the pencil's tip. It tins more readily than other metals and it is less subject to oxidation. These tips heat to 600° F in 90 seconds.

The second application shown is a series of parts for use in the electrical switchgear industry. These were machined from 3/8" to 1-1/4" round, hexagonal and square Noranda Tellurium Copper rod.

The third example is a holder for a current-carrying bimetal contact. Electrolytic Copper was first specified for this part. Its machining characteristics made the important slotting operation difficult. The problem was solved by using Noranda Tellurium Copper.

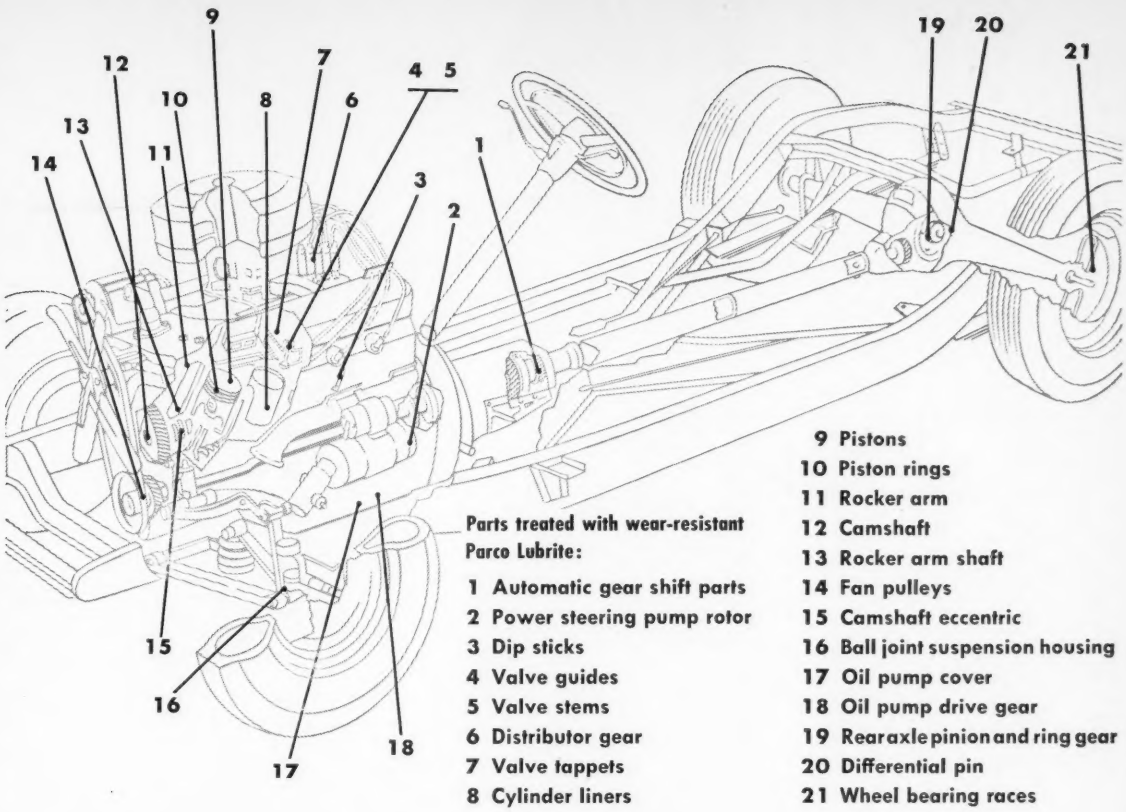
Noranda Research and Service

Tellurium Copper is just one of the many copper-base alloys produced by Noranda to solve specific problems. Each is the result of extensive research and development conducted by the Noranda Laboratory in close cooperation with fabricators and users in terms of their requirements.

Noranda Tellurium Copper, or one of the many other engineered Noranda alloys, may well be the answer to your particular problem. Our Technical Service Department and Laboratory will be glad to work with you on the application of these metals to your products. Contact your nearest Noranda Sales Office for immediate service. (2547)

Chemical & Physical Properties of Noranda Tellurium Copper

ANALYSIS		
Copper %		99.5
Tellurium %		0.5
MECHANICAL PROPERTIES (rod 1-in. dia.)		
Ten. Strength, psi	Hard	48,000
	Half Hard	42,000
Yld. Strength, psi (½" extension)	Hard	46,000
	Half Hard	39,000
Elong. % (2-in.)	Hard	20
	Half Hard	35
Rockwell Hardness	Hard	B50
	Half Hard	B45
PHYSICAL CONSTANTS		
Specific Gravity		8.94
Density, lb/cu. in.		0.323
Elec. Conductivity, % (IACS at 68 F)		90.0
Thermal Conductivity (Btu/sq ft/ft/hr/F at 68 F		205
Mod. of Elas. (Ten.) 10°psi		17
Coef. of Ther. Exp. (per °F, from 68-570 F) x 10°		9.8
FABRICATING PROPERTIES		
Machinability rating		90
Cold working		Good
Hot working		Excellent
Hot working range °F		1400-1600
Comm. anneal range, °F		700-1200
JOINING PROPERTIES		
Soft soldering		Excellent
Brazing		Good
Inert-Gas Arc Welding		Good



Parts treated with wear-resistant Parco Lubrite:

1 Automatic gear shift parts
2 Power steering pump rotor
3 Dip sticks
4 Valve guides
5 Valve stems
6 Distributor gear
7 Valve tappets
8 Cylinder liners
9 Pistons
10 Piston rings
11 Rocker arm
12 Camshaft
13 Rocker arm shaft
14 Fan pulleys
15 Camshaft eccentric
16 Ball joint suspension housing
17 Oil pump cover
18 Oil pump drive gear
19 Rear axle pinion and ring gear
20 Differential pin
21 Wheel bearing races

The automotive industry shows how to save money by using Parco Lubrite

Wearing surfaces—the vital parts that move or roll or slide against each other—can cost the manufacturer far more than their original price.

If one of them fails prematurely in use, because of improper break-in, there's the cost of replacement, the field service charge, and the customer's ill-will to be reckoned with.

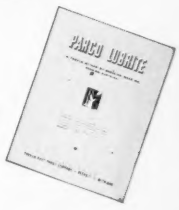
To promote smooth, safe initial operation, to prevent galling, scoring and welding, and to lengthen subsequent life, friction parts should be treated with Parco Lubrite.

This nonmetallic, oil-holding coating eliminates metal-to-metal contact during wearing-in, keeps a film of lubricant between bearing surfaces, provides priceless protection for fractions of pennies.

Automobile manufacturers have cut field service costs by the use of Parco Lubrite. How about *your* product? Let the Parker technical representative investigate for savings!

DETAILED TECHNICAL INFORMATION

Technical bulletin, with photomicrographs and data, on Parco Lubrite wear-resistant coatings. Send for it. It's free.



Since 1914—leader in the field

PARKER RUST PROOF COMPANY
OF CANADA LTD.
Rexdale Blvd., Rexdale (Toronto), Ontario

BONDERITE corrosion resistant paint base
BONDERITE and BONDERLUBE aids in cold forming of metals
PARCO COMPOUND rust resistant
PARCO LUBRITE wear resistant for friction surfaces
TROPICAL heavy duty maintenance paints since 1883

**Bonderite, Bonderlube, Parco, Parco Lubrite, Parker Pre-Namel—Reg. U.S. Pat. Off.*

Self-aligning

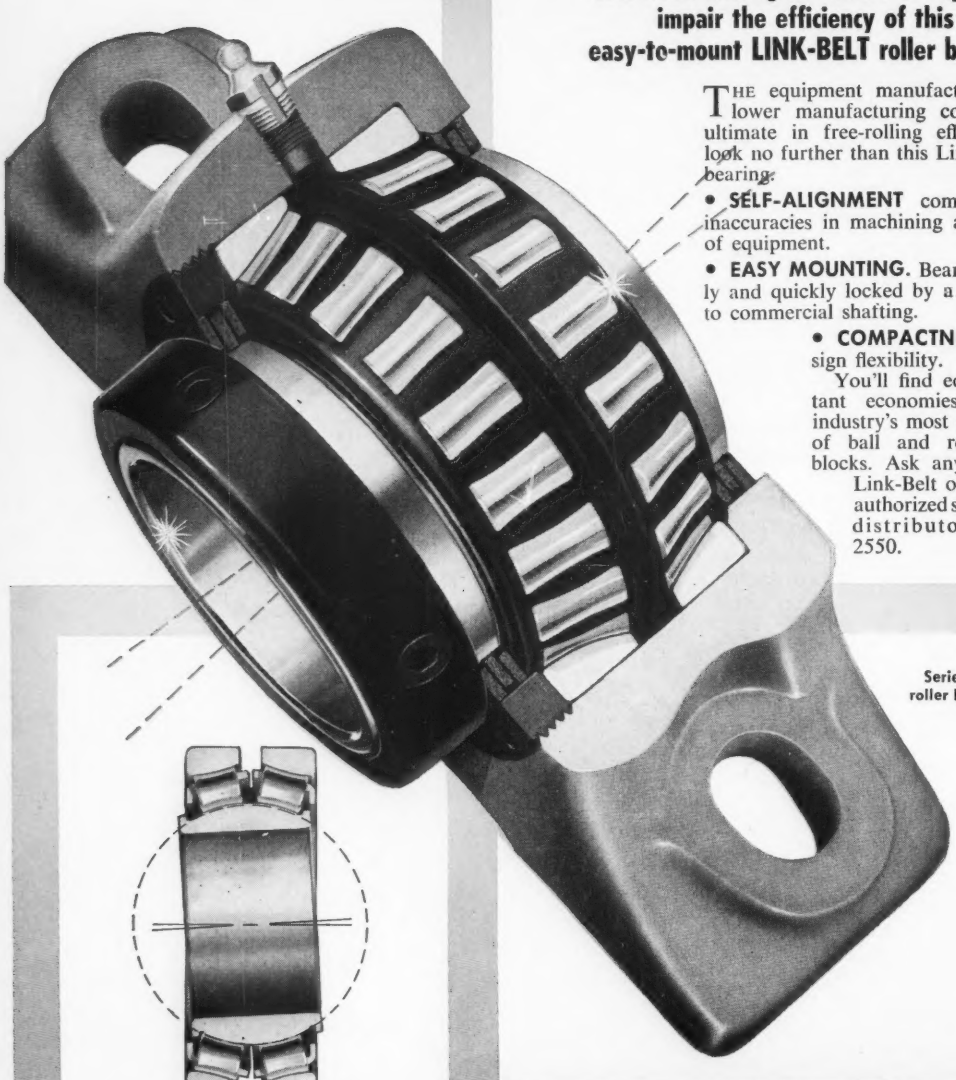
FOR LONGER LIFE

Not even misaligned shafts or supports impair the efficiency of this easy-to-mount LINK-BELT roller bearing

THE equipment manufacturer seeking lower manufacturing costs plus the ultimate in free-rolling efficiency need look no further than this Link-Belt roller bearing.

- **SELF-ALIGNMENT** compensates for inaccuracies in machining and assembly of equipment.
- **EASY MOUNTING.** Bearing is securely and quickly locked by a heavy collar to commercial shafting.
- **COMPACTNESS** offers design flexibility.

You'll find equally important economies throughout industry's most complete line of ball and roller bearing blocks. Ask any one of the Link-Belt offices or your authorized stock-carrying distributor for Book 2550. 14,440-C



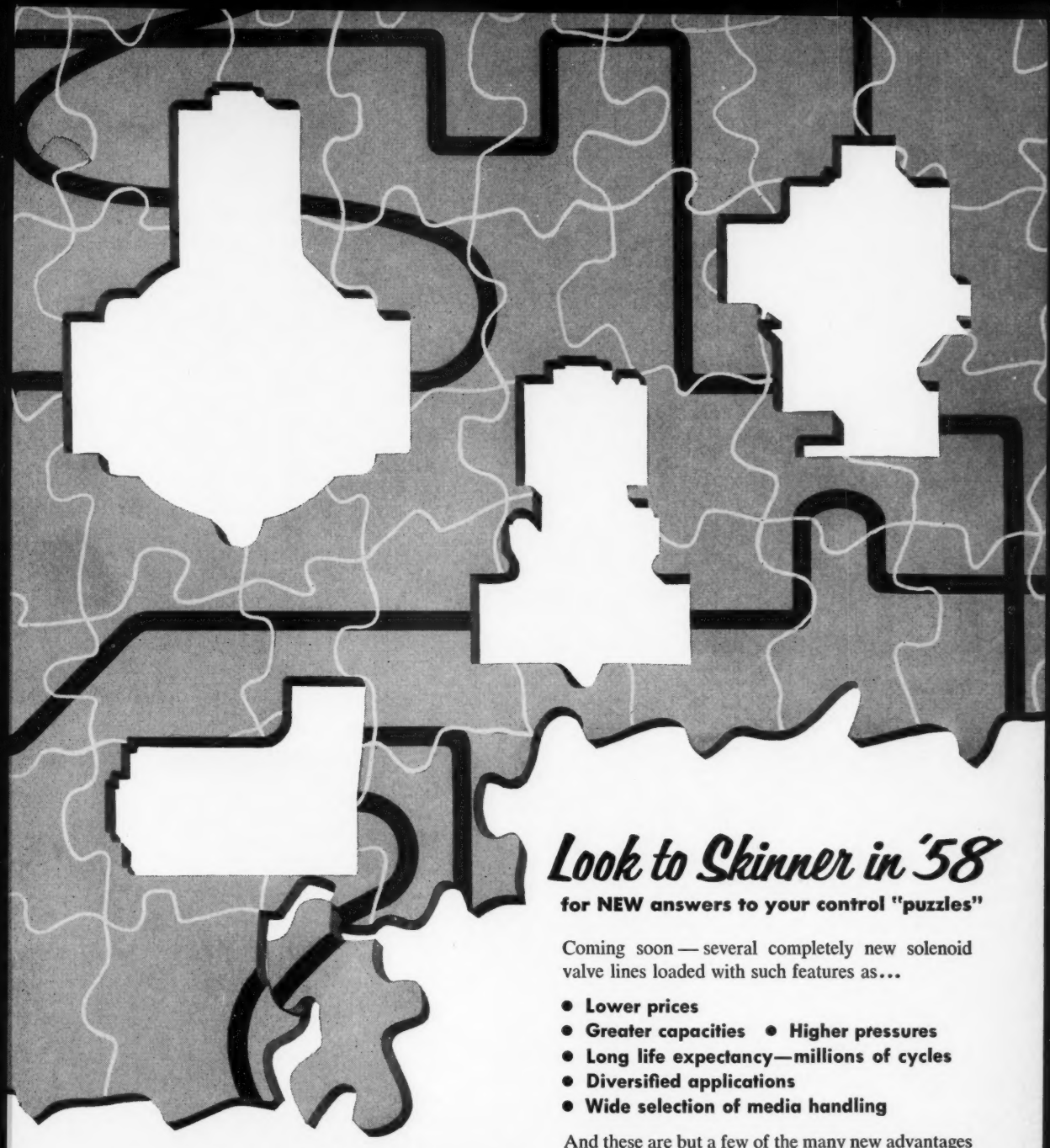
Series 400 roller bearings

FREE ROLLING—SELF ALIGNING. Spherical inner ring aligns freely in any direction. Load is distributed over entire roller, assuring full capacity. Destructive edge loading cannot occur.

LINK-BELT

self-aligning ball and roller bearings

LINK-BELT LIMITED: Scarboro Plant, General Offices and District Sales—1960 Eglinton Avenue, E., Scarboro, Ont., Station H, Toronto 13 • Eastern Avenue Plant and Factory Branch Store—731 Eastern Avenue, Toronto 8 • Sales Offices and Factory Branch Stores—Montreal 15: 945 Beaumont Avenue • Vancouver 12: 2550 Boundary Road • Winnipeg 10: 1315 Portage Avenue • Swastika, Ont.: 8 Boisvert Street • Halifax: Austen Bros. Ltd., 118 Hollis Street • District Sales Offices—Hamilton: 605 James Street, N. • Sydney: Austen Bros. Ltd., 361 George Street • Foundry at Elmira, Ont., 19 Church, Street, E.



Look to Skinner in '58

for NEW answers to your control "puzzles"

Coming soon — several completely new solenoid valve lines loaded with such features as...

- **Lower prices**
- **Greater capacities** • **Higher pressures**
- **Long life expectancy—millions of cycles**
- **Diversified applications**
- **Wide selection of media handling**

And these are but a few of the many new advantages of Skinner's new solenoid valves. As always, of course, they'll be strictly manufactured to Skinner's highest-quality engineering standards.

Look for the announcements of Skinner's new valve lines in these pages throughout 1958. For advance information, write Dept. 351.

Most important, these new valves will give you performance and applications that heretofore have not been possible!

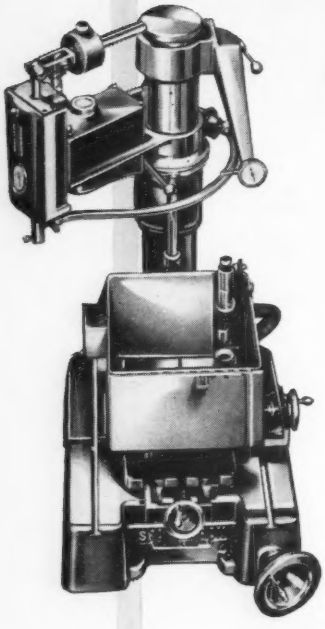
SKINNER ELECTRIC VALVE DIVISION
NEW BRITAIN CONNECTICUT
105 EDGEWOOD AVENUE

. . . SPECIALISTS IN THE FIELD OF ELECTRO-MACHINING . . .

THE SPARCATRON MARK III

6.5 KW ELECTRICAL DISCHARGE MACHINE

TOMORROW'S TOOL AND DIE MAKING METHOD . . . TODAY!

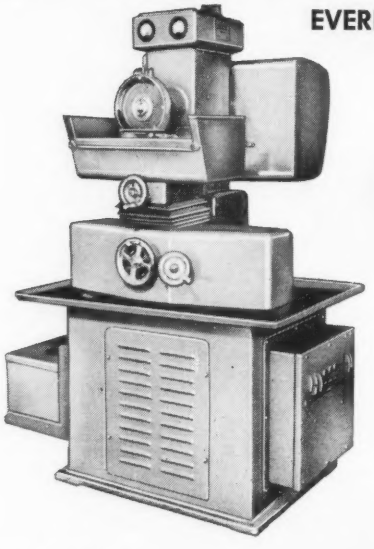


The use of Sparcatron equipment makes it possible for your Production to accept designs which were previously not practical for production purposes. The more complex the shape of the die, the greater the need for spark machining. Its use covers all forms of die-making in forging and stamping dies, extrusion dies, blanking dies, drawing dies, and some types of form tools.

EVERITE ELECTROCHEMICAL

Machine Tool H-2

for sharpening carbides



The new concept in machining that means greater efficiency . . . lower costs for your shop.

Grinds without abrasion:

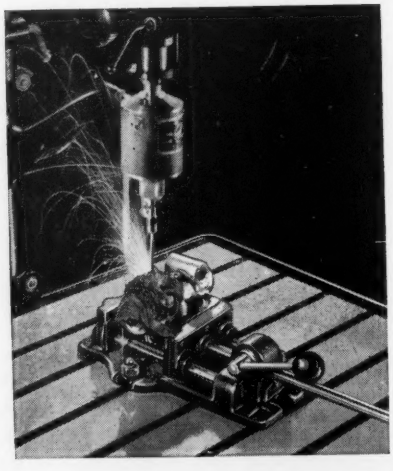
- **Negligible diamond wheel wear**
- **Fine uniform surface finish**
- **Increase in tool life**
- **Fast metal removal**
- **Eliminates rejects due to thermal cracking**
- **Simultaneous shaping of carbide and shank**
- **Roughing, finishing in one operation**
- **Low overall cost**

For unequalled speed and economy in removing broken drills and taps

ELECTRO ARC

METAL DISINTEGRATORS

quickly remove broken drills, taps, studs, etc. — pierce hardened steel and tungsten carbide — faster and at lower cost than any other machine. They produce holes of any shape to which an electrode can be made — without marring or annealing the work. There are versatile models for every requirement of tool room, job shop, and production department. With a few minutes' practice, any shop man can use them to full advantage.



TRADE MARKS

B.S.A

B.S.A. TOOLS LIMITED, Toronto 18, BE 3-1209

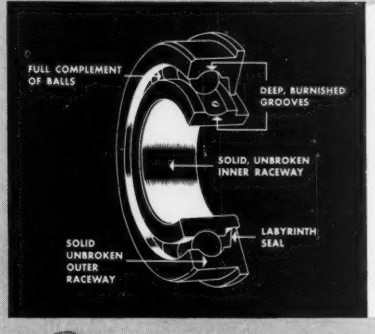
Write for descriptive literature!

THE NEW HEIM Unibal® BALL BEARING

This new, ingenious method of ball bearing assembly means . . .

Lower Prices

The simplicity of its construction avoids costly, extra assembly devices and results in fewer component parts, which fit together easily to form a smooth running bearing. Unibal is a premium quality commercial ball bearing, delivering superb performance at prices substantially lower than ground ball bearings.



Compared with conventional commercial ball bearings, longer life is attained and both radial and axial load capacities are increased by the sturdy, one-piece raceway construction.

Note this unusual construction (patents pending):

- Solid, unbroken, machined outer and inner raceways.
- Deep, burnished ball grooves with a full complement of balls.
- Both raceways are deep carburized and hardened.
- Labyrinth seals on one or both sides.

Available in single row, double row, with or without flanges; extremely narrow widths and small diameters; to close tolerances and controlled radial and axial play.

HEIM is also the originator of the Unibal® Spherical Bearing Rod End.

Write for catalog and special bulletin with load ratings and dimensions.

RBM BEARINGS CANADA LTD.

QUEBEC CITY	MONTREAL	WINNIPEG	THREE RIVERS	TORONTO	VANCOUVER	LONDON, ONT.	HAMILTON
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Ward Leonard's Vitrohm...

the rheostat that wears many hats

Why do motor and generator builders prefer – and specify – Ward Leonard Vitrohm rheostats?

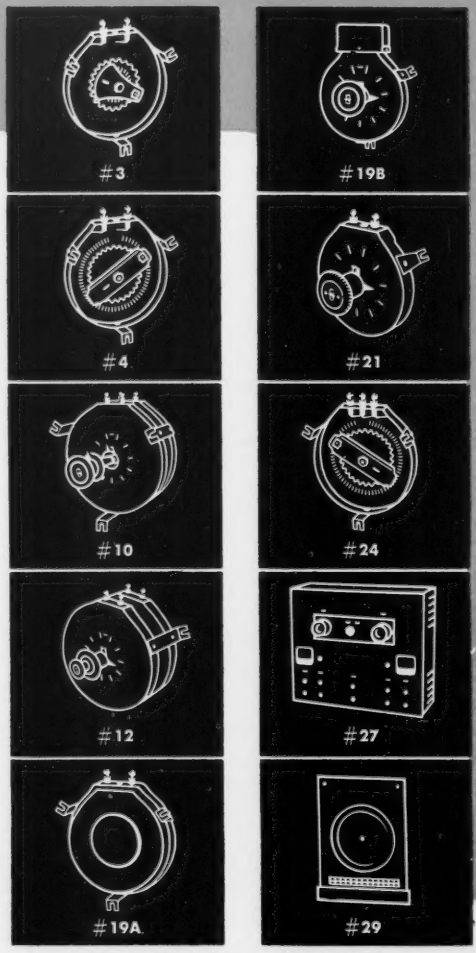
It's because the tremendous variety of standard accessories we build enables our rheostats to fit exact job requirements.

Standard Ward Leonard Vitrohm rheostats ranging from 120 to 3200 sigma watts (per plate) are available for mounting front or back of panel – in single or multi deck and in combinations of small and large plates – with single or concentric drive – and for manual or motor operation.

You get this exceptional versatility along with Ward Leonard's famous Vitrohm construction – steel plate foundation and large rectangular brass contacts embedded in vitreous enamel. Adds up to more rheostat for your money – when you shop at Ward Leonard.

For information on Vitrohm rheostats, send for fully illustrated, data-packed catalog #60. Write Ward Leonard of Canada Ltd., 1070 Birchmount Rd., Toronto 16.

#3 Rear view 8" rheostat with standard contacts
#4 Rear view 8" rheostat with multistep contacts
#10 2 deck rheostat for back of board; single handwheel
#12 2 deck rheostat for front of board; concentric handwheel
#19A Rheostat with enclosing cover
#19B Rheostat with cover and conduit fitting
#21 Rheostat with adjustable stop
#24 3 terminal rheostat for potentiometer connection
#27 Special panel for extruder and capstan take-up
#29 Special motor operator for variable speed drive



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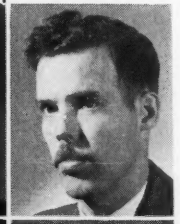
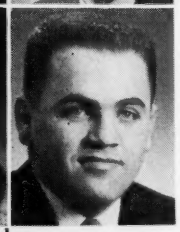


Parsons

Savage



Shortt

G. L. McMillin and **G. A. Gowdy** of Canadian Steel Foundries (1956) Ltd. The former becomes president and general manager, the latter a director.

• • •

I. A. Mayson, B.A.Sc., P.Eng. of CGE. He is now marketing manager of the electronic equipment and tube department.

• • •

Walter L. Buckenhizer of Houdaille Industries Ltd. He's now vice-president in charge of all manufacturing.

• • •

Denton Massey, AMF Atomics (Canada) Ltd. A vice-presidency and directorship.

• • •

J. S. Parsons, Computing Devices of Canada Ltd. A vice-presidency (engineering).

• • •

Ernest A. Ford, Robert J. A. Fricker, MacKenzie McMurray and **Palmer A. Savage**—all of Dominion Bridge Co. Ltd. Ford, v-p, marketing: Fricker, v-p, manufacturing: McMurray, v-p, finance and administration and Savage, v-p, engineering.

• • •

Dennis C. Champ and **John W. Shortt** of Bakelite Co. Both become technical representatives.

• • •

M. F. Goudge of the Department of Mines and Technical Surveys. Goudge has won the McCharles Prize which carries with it a medal and a $1000 grant.

• • •

R. W. Cornell, P.Eng. of Honeywell Controls Ltd., Ottawa district manager.

• • •

W. W. H. Dean, Roy H. Ferguson, L. D. McConnell, D. H. McKeough, E. E. Orlando, E W. Piercy, C. C. Smith and **A. K. Wickson**—all of Canadian Westinghouse.

Dean, marketing manager, atomic energy division: Ferguson, district apparatus division's application engineering department manager: McConnell, section engineer in charge of oil circuit breakers: McKeough, section engineer in charge of gas circuit breakers: Orlando, v-p, apparatus and industrial sales: Piercy, manager of the small motors department at Stratford: Smith, manager of circuit breaker engineering: Wickson, engineering manager of the defence apparatus division.

• • •

George S. MacDonell of CGE, marketing manager of the lamp department.

• • •

J. Roy Gordon, who is executive v-p of International Nickel Co. of Canada Ltd. and the International Nickel Co. Inc. has been awarded the A.I.M.E. Douglas Medal for distinguished work in process metallurgy in smelting and refinement of nickel.

• • •

Dr. Robin I. Primich of the Defence Research Telecommunications Establishment, cited at the Canadian IRE convention for "the most significant scientific presentation published last year on microwave techniques."

• • •

W. H. Jackson, B.Sc., of de Havilland Aircraft of Canada, assistant to the managing director.

No time like the present

LOTS OF YOU ENGINEERS have the nucleus of an article tucked away in a drawer somewhere, either in the form of rough notes or as a rough typescript.

The reason, of course, that you haven't done anything about it is because you probably feel that nobody will be interested in publishing it—so why do all the work necessary to get it in shape for nothing?

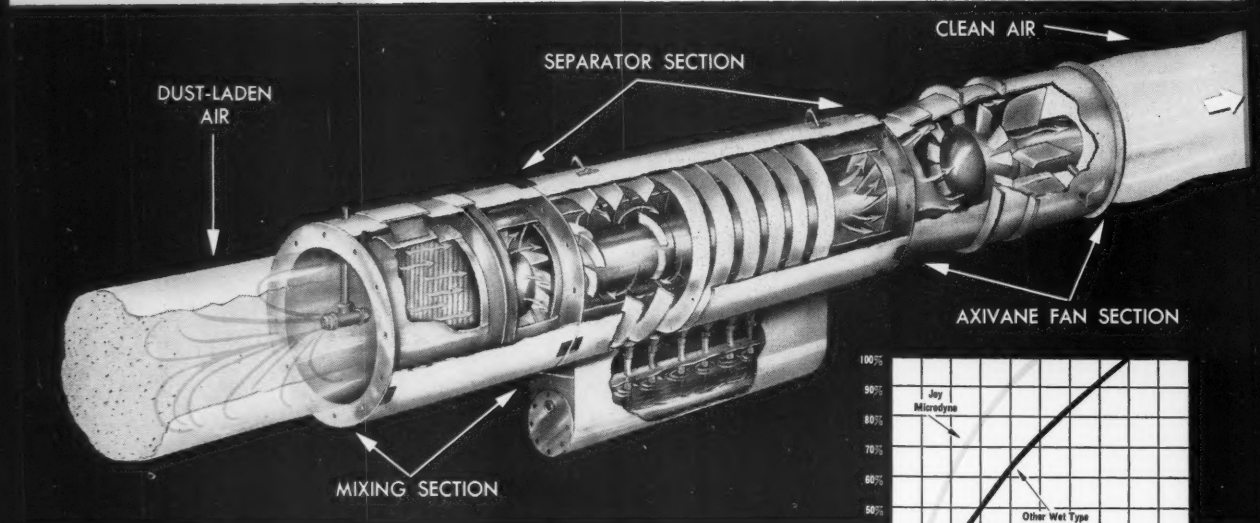
There is somebody interested in your technical article: DESIGN ENGINEERING is always on the lookout for suitable contributions. Not that we are short of material, mind you. But it does seem a pity that good stuff should not see the light of day.

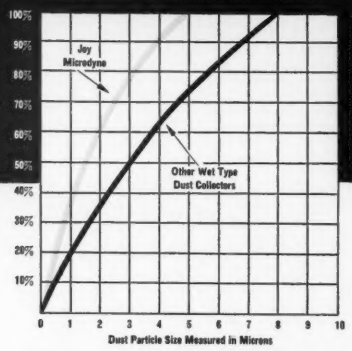
Why not act at once and tidy up that article, get it typed and submit it to DESIGN ENGINEERING? If we like it enough to publish it, you will be paid. Not a fortune, perhaps, but enough to make it worth your while.

And think of the personal satisfaction of seeing yourself in print.

IT'S NEW!

THE COMPACT, HIGH EFFICIENCY JOY MICRODYNE DUST COLLECTOR





1/10 to 1/20

THE SIZE OF ANY OTHER DUST COLLECTOR

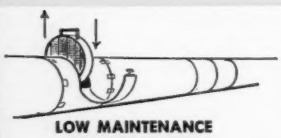
Here's a new, wet-type dust collector with an efficiency rating of over 99% down to 5 microns, yet so small and compact it fits where no other collector could. Your own maintenance crew can bolt it easily into existing duct-work, often right where dust originates. Air-borne dust particles, drawn into the mixer section by a Joy Axivane fan at the rear of the collector, are entrained by water after impact on an impingement element. Dust encased in water droplets passing to the second section are directed by centrifugal force to the wall of the cylinder, thence to a sump below, where the slurry can be pumped or drained away. Low power and water requirements result in unusually low operating cost.

CAN BE INSTALLED WHERE NO OTHER DUST COLLECTOR COULD FIT

Fits into existing ductwork, often right at point of use.

CLEANS 2500 to 64000 CUBIC FEET EACH MINUTE

There is a Joy Microdyne model designed to meet the special conditions of the application.



LOW MAINTENANCE AND POWER COST

Self-cleaning impingement unit is easily removed. Power requirements are unusually low.

LOWEST COST PER CFM FOR THESE TYPICAL APPLICATIONS

- Metal scale in steel plants and foundries
- Air-borne sand in foundries
- Cleaning air contaminated in mining operations
- Coal dust at screening and drop-off points
- Wherever crushing or grinding operations occur
- Recovery in Uranium mining
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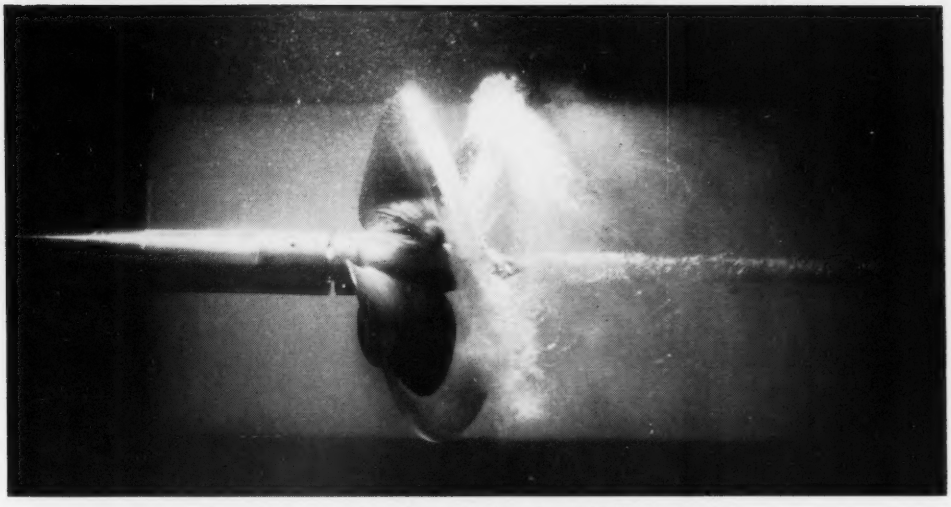


Propeller operating in fixed location. Failure to study design criteria may result in power losses and cavitation.

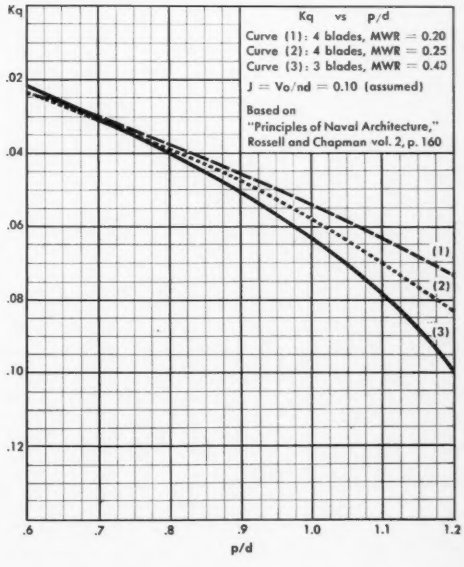
Estimating propeller performance

Notes on estimating performance of a propeller in a long flume

G. G. M. Carr-Harris, P.Eng.

The characteristics of a propeller depend, in general, on five basic factors; the diameter, the pitch, the blade area, the blade cross section and the speed of rotation. With these are associated the power input to the shaft, the propeller efficiency and the speed of advance of the ship. Such relationships are expressed (wherever possible) in terms of the nondimensional ratios, pitch ratio (defined as the propeller pitch divided by the diameter p/d) or mean width ratio (the mean width of one blade divided by the propeller diameter MWR). Both these ratios are related to the torque and power input, as illustrated in the example that follows.

Pitch ratios for most marine propellers fall within the range 0.6 to 2.0, the lower values being used for the heavily loaded tugboat type and the higher values for the lightly loaded motorboat type. Thus, for the present case it may be assumed that only pitch ratios between 0.6 and 1.2 would apply. Experience indicates also that the mean width ratio of an ordinary propeller falls within the range 0.2 to 0.4, the former figure



being generally applicable to 4-blade propellers and the latter to 3-blade types.

From information to be found in Chapter 3 of "Principles of Naval Architecture," Volume 2, 1939, by Rossell and Chapman (published by the Society of Naval Architects and Marine Engineers, New York), curves for a torque coefficient (K_q) can be constructed for propellers with the foregoing characteristics and for small values of the speed of advance (that is, approaching zero). It is not proposed to discuss in any detail the nature of the information given there; suffice it to say, however, that for any specified set of conditions K_q depends on p/d and MWR.

As a practical example, assume a propeller with a diameter of 20 in. and a pitch of 18 in. revolving at 480 rpm. These are purely arbitrary assumptions and are not necessarily representative of good design practice.

Since the water would have some velocity in approaching the propeller (possibly about 1 or 2 fps) it might be reasonable to assume a speed of advance of 1.5 fps. On this basis, and also assuming MWR equals 0.2 and 0.25 for 4-blade and 0.4 for 3-blade propellers, the data shown in the table can then be deduced from the "Propeller Design Charts" in the above text (charts 1, 2 and 4 on pages 160-7).

Note. In order to use these charts it is necessary to fix a value for J in the relation $J = V_o/nD$. Here V_o is the speed of advance (fps), n is the propeller speed (rps) and D the propeller diameter (ft). For the conditions assumed in this example, J = 0.10; for any other value of J, the tabulated values for K_q would have to be modified.

From the above data, three sets of curves can be drawn for the three different values of MWR giving K_q in terms of p/d. With our value of p/d = 0.9 and assuming a 4-blade propeller with MWR = 0.20, $K_q = 0.045$. Similarly, for a 3-blade type, $K_q = 0.050$.

It is now possible to calculate the torque on the propeller from the equation: $Q = K_q \times \rho \times n^2 \times d^5$

where
- Q = torque (ft.lb)
- ρ = density = 1.938 (slugs per c.ft for fresh water)
- n = revs per sec
- d = propeller diameter (ft)

Thus for 4-blades,

$$Q = 0.045 \times 1.938 \times (8)^2 \times \left(\frac{20}{12}\right)^5 = 71.5 \text{ ft. lb.}$$

$$\text{Power} = \frac{2\pi nQ}{550} = \frac{2\pi \times 8 \times 71.5}{550} = 6.5 \text{ hp.}$$

A similar procedure could be followed for calculating the power requirements of a 3-blade propeller with

p/d	K_q (MWR = 0.20)	K_q (MWR = 0.25)	K_q (MWR = 0.40)
0.6	0.023	0.023	0.022
0.80			0.039
0.90	0.045	0.047	0.050
1.0			0.063
1.05	0.058	0.063	
1.20	0.073	0.083	0.098

$K_q = 0.050$. In this case it would be

$$6.5 \times {}^{.05}/_{.045} = 7.21 \text{ hp,}$$

showing some power increase by using a 3-blader.

The procedure outlined above could be used also to fix values for p/d and MWR working backward from a given power input. In this way the ruling dimensions of a propeller for some specific application could be settled.

So much depends on the nature of the application and the character of the flume, that it would be impossible to offer more than very general comments. One application may be mentioned, however: the accelerated movement of logs in a mill pond. By building a simple flume with no bottom to it and with sides extending some feet below the surface, logs could be fed in at one end and transported several hundred feet, depending on the velocity of the water. In such a case the propeller could be motor driven with suitable transmission gearing. It might be advisable also to consider several propellers rather than to rely on one large one.

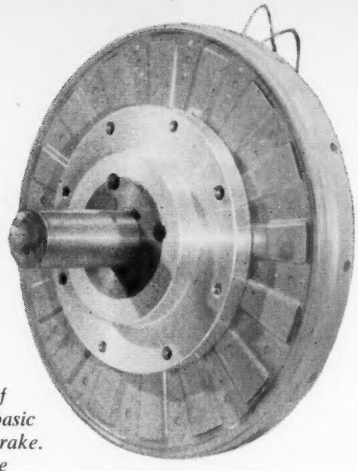
It should be noted, however, that the charts published by Rossell and Chapman (from which the above deductions have been drawn) apply to propellers running free, that is, without ducts or shrouds. If a large propeller is placed in a narrow flume (or if the flume is constructed with a bottom) the shrouding effect may be an important factor. Such an installation would therefore call for a somewhat different treatment than that given here.

Other things being equal, the water velocity through the flume could be increased either by increasing the propeller speed or by increasing its diameter. In the former case the power required would vary with the cube of the propeller speed so that, with a 1.56 increase in speed (say from 320 to 500 rpm), the power would have to be increased 3.8 times. ★

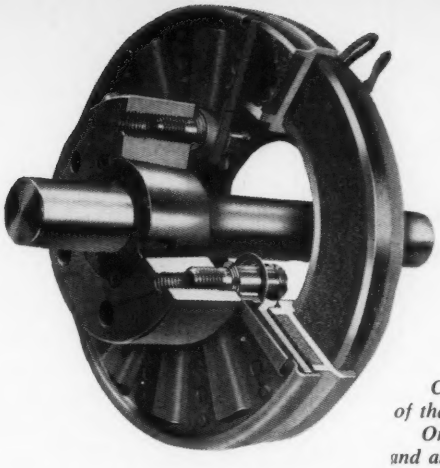
Propeller design is based essentially on the concept of a vessel moving through water. In this connection, a great deal of experimental data is available to the designer, based on the relation between the moving blades and the speed of the ship (also known as the "speed of advance"). When it becomes necessary (as in a nonmoving installation) to investigate the performance of a propeller with a zero (or very small) speed of advance, it will be found that little relevant data is obtainable. Such a case might arise, for instance, in locating a propeller at one end of a long flume to accelerate the passage of water through it.

The preceding notes have been prepared to help in estimating the performance of a propeller in such a location and an actual example is worked out. Certain assumptions have been made and the example is given merely to illustrate how a case of this kind might be studied.

It should be mentioned that problems associated with the design of marine propellers have been discussed in T.I.S. Report No. 40.



Largest of the four basic sizes of brake. This is the 1525 model.



Cutaway of the brake. Only face and armature can wear.

Brakes that can claim to be fail-safe

A new line of brakes that combines high torque and fast cycling, with the ability to hold or stop a load if power fails, is announced by Warner Electric Brake & Clutch Co. They are called "Power-Safe" brakes, and are essentially two brakes.

Four basic sizes of brake are currently listed as standard, with other sizes to be added in the future as required. Power torque ratings range from 125 to 650 lb ft and fail-safe torque ratings from 33 to 205 lb ft. Models are also available that provide the fail-safe feature with electrical release but without power braking. Basic model designations are PER-825, 1000, 1225 and 1525.

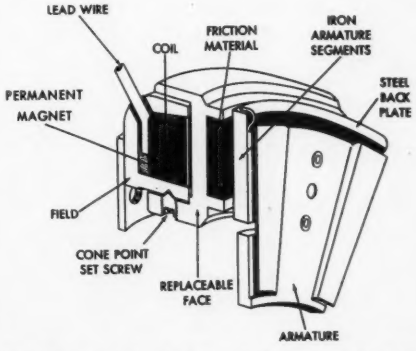
Extremely simple operation is an outstanding characteristic of the brakes. The entire brake has a minimum number of moving parts, with no moving parts in the fail-safe mechanism. There is no friction on the field or magnets, so they never need replacing. All that will ever have to be replaced (it is claimed) are the face and the armature, and even these (they are the cheapest components of the brake) have an extremely long life. The brakes are self-adjusting for wear and have no bands, links, cams or adjusting screws to worry about.

A major advantage in many installations is the extremely compact design. The brakes are easy to mount with either inside bolt circle or outside mounting flange. With a special adapter, they can be mounted to any NEMA "C" flange and used as a motor brake for a broad variety of machinery applications. Exceptionally fast stop-start control for all types of industrial equipment is possible when the brakes are coupled to a Warner electric clutch.

The brake consists of a stationary field, replaceable face and armature. A ring of permanent magnets imbedded in the face of the field provides the fail-safe feature that holds the brake in position with the power turned off, or in the event of power failure. The flux path with the power off is concentrated through the armature, because the field shell, which offers the alternate path, is designed with a higher reluctance or resistance to the magnetic flux.

The wound coil located in the field also produces magnetic lines of force, with their direction depending on how the coil is connected to the dc power supply. To release the brake, current is passed through the coil so that its magnetic field is set up in the same direction as that of the permanent magnets. This results in a building up of the flux path through the permanent magnet and the field shell and a reduction of the flux through the armature. The attraction between the armature and the replaceable face is weakened to the point that the release springs in the autogap accessory push the armature clear, thus effectively releasing the brake.

When used as a power brake, the current in the coil is reversed, so that its flux lines oppose those of the permanent magnets. This results in the permanent magnets offering high resistance (or being a high reluctance path) to the electromagnetic flux. As a result, this flux now takes its path through the armature, replaceable face and the field shell, stopping rotation of the armature. ★



Magnets are buried in stationary field face.

Warren J. Maciver

Theory of a good belt conveyor system

When is it necessary to use a dual motor drive on a belt conveyor?

With few exceptions, most large or "heavy" belt conveyors today are powered by the typical traction drive of a single drive pulley. The drive pulley may operate with a non-driven snub pulley behind it to provide a greater angle of wrap and hence greater traction or pull. Generally, the drive pulley is located at the head (or discharge end) of the belt, but it can also be located at the tail end or at some intermediate point along the carrying or return run.

A few large belt conveyors carrying heavy bulk materials over comparatively long distances (800 ft. or more) are driven by two drive pulleys located close together at the head end, near the tail end or at some intermediate point along the return (lower) belt run. These two drive pulleys are driven at approximately the same speed by two motors with one set of controls. Both motors could be squirrel-cage induction type, wound rotor or a combination of synchronous motor with slip-ring type. The choice is governed by the type of control or drive coupling to be used.

The first or foremost driving pulley is known as the **primary**; it provides the major share of the tractive pull required to move the belt. The other pulley (the **secondary**) provides the remainder of the pull required. But with the electrical controls used, both motors tend to equalize their share of the pull. The angle of wrap of the belt around the primary may be greater or less than the wrap around the secondary pulley. It could be (but in practice seldom is) the same. This wrap on the primary ranges from a minimum of 180 deg up to a maximum of 240 deg. Thus the two pulleys combined provide a total angle of belt wrap in excess of 360 deg. It may be as high as 440 deg.

From this descriptive outline we are faced with an important question, the answer to which involves an examination of both economic and engineering factors: When is it advisable or necessary to use a dual-motor drive on a belt conveyor?

Advantages of a dual motor drive

The average angle of belt wrap is 185 deg for the usual drive having a single drive pulley without an adjacent snub pulley. For the single pulley drive with a snub pulley it is 220 deg, and for the dual-motor drive (with two drive pulleys and snub pulleys on both sides of the secondary) the total angle of belt wrap averages about 420 deg.

Let us examine (in the Table) the ratios of

$$\frac{\text{Tight-side belt tension}}{\text{Slack-side belt tension}}$$

or T_1/T_2, for these basic types of drive with their varying amounts of belt wrap.

Notice the difference in ratio between the two extremes of belt wrap. Only 2.24:1 for a single drive pulley without rubber lagging and without an adjacent snub pulley; up to a maximum of 13:1 for two rubber-lagged drive pulleys, with adjacent snub pulleys providing 420 deg total angle of belt wrap. That is, for the latter, the tight-side tension (T_1) is 13 times as great as the slack-side tension (T_2) at the point where the belt finally leaves the drive at the secondary pulley.

Since the effective tension required to move the belt (T_E) is the difference between the tight-side and slack-side tensions where the belt enters and leaves the drive (or $T_E = T_1 - T_2$), it is seen that, with increasing angles of belt wrap, the ratio of tight-side tension (T_1) to the effective horsepower pull (T_E) decreases towards 1. When that theoretical extreme point is reached, all the strength of the belt would be available for moving the load and overcoming friction. Actually the ratio T_1/T_2 never does reach unity. For the example of 420 deg total angle of wrap in Table 1, the tight-side tension (T_1) is only 8% more than the effective driving tension (T_E) because:

$$\frac{T_1}{T_E} = \frac{T_1}{T_1 - T_2} = \frac{13.0T_2}{13.0T_2 - T_2} = \frac{13.0T_2}{12.0T_2} = 1.08$$

This ability to make use of such a high percentage of the available tensile strength of the belt as effective driving tension (with its corresponding low amount of slack-side tension remaining) is the major advantage of the dual-motor, two-pulley driver over the usual single-pulley drive.

Other advantages may be listed which are practical considerations of installation, operation, access for servicing, cost and so forth. A few of these other advantages are:—

(1) Two smaller motors with less weight located over a larger floor area (or on two separate floor levels) result in lower floor loading and lighter steel supporting beams.

(2) There is more flexibility of drive arrangement in locating two drive pulleys with two or more snub pulleys than in locating one drive and one snub.

(3) As the commercial sizes of large motors (300 hp and more) usually come in increments of 25 or 50 hp, less surplus hp would often be installed using two motors instead of one. For example: there is less waste of power in driving a belt conveyor requiring 565 net hp at the driveshaft by using one 400 and one 175 hp motor than a single 600 hp motor.

Distribution of belt tensions

Let us start with a simple review of the basic principles involved in the design of any belt conveyor.

A conveyor belt moves because the rubber surface of its underside is in contact with the cast iron, steel or rubber-lagging surface of a revolving drive pulley. To maintain this surface contact or grip throughout its angle of wrap, some tension (or pull) is needed in the belt, not only at the point where it contacts the pulley, but also at the point where it leaves the pulley. The larger tension in the belt as it contacts the pulley is known as the tight-side tension (T_1) in most formulas of tension. The lesser tension remaining in the belt as it leaves contact with the pulley is known as the slack-side tension, (T_2).

The difference between these two tensions is the actual amount of effective tension (T_E) required to move the loaded conveyor belt.
This relationship is expressed as:
Effective tension (T_E) = Tight-side tension (T_1) − Slack-side tension (T_2).

In the customary formula expressing horsepower:

$$hp = \frac{F(\text{driving force}) \times S(\text{speed in fpm})}{33{,}000}$$

The effective tension (T_E) of the conveyor belt replaces the symbol F. The formula thus becomes:

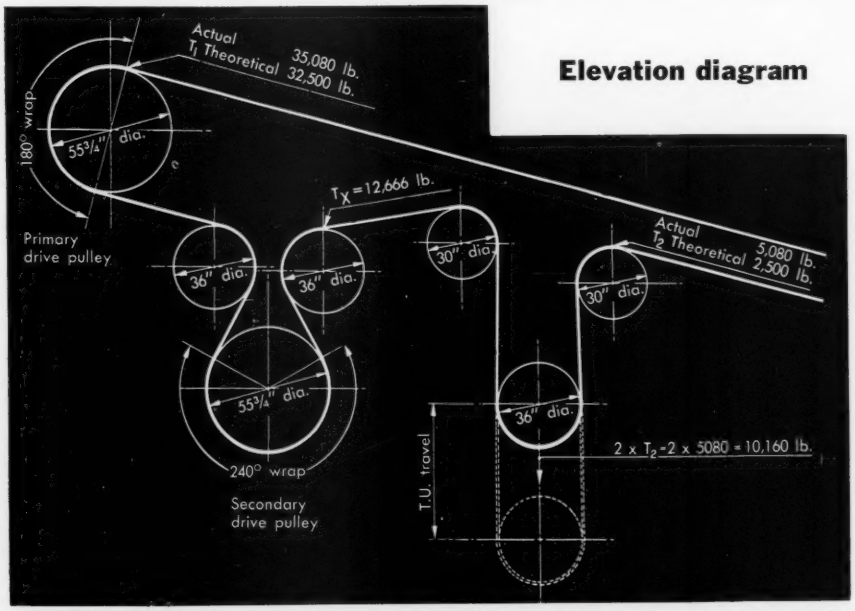
$$hp = \frac{T_E \times S}{33{,}000} \quad \text{or} \quad T_E = \frac{hp \times 33{,}000}{S} \quad \ldots \text{Eqn.(1)}$$

In conveyor belt design the hp formula on the left is not used initially to determine the hp requirements. The formula on the right is first used to determine the effective tension only after the figures for several components of hp are read from hp tables in a manufacturer's handbook or catalogue.

The following components of horsepower are read from these tables:
(1) hp required to move the empty belt. The amount of this component is practically the same whether the belt is horizontal or inclined, because on sloping belts the upwards pull on the carrying run is offset by the downward pull of the lower return run.
(2) hp required to move the load horizontally. Figures from tables for various tonnages and belt lengths.
(3) hp required to elevate the load (on sloping belts). Figures in this table are based on the formula:

$$hp = \frac{TPH(\text{tons/hr.}) \times H(\text{lift in ft.})}{990}$$

(4) Additional hp for friction losses when the belt travels around snub pulleys of a tripper,



1. Elevation of dual motor drive for 36 in. belt conveyor showing primary and secondary drive pulleys with 180 and 240 deg. wrap. Take-up and bend pulleys are at right.

where one is used. Figures in the table for various belt widths and trippers having anti-friction or babbitted bearings.

(5) Additional hp for friction losses in the drive. Usually a percentage of the total of (1), (2), (3) and (4) above, depending on the type of prime mover and reducer or reduction drive used.

The total hp obtained by adding the components is then used to solve Eqn. (1) for the effective belt tension.

The amount of this effective tension is a fixed quantity that does not change, no matter what type of drive is used. It is determined solely by the capacity of the material handled, the layout of the conveyor being designed and the selected belt width and speed. The difference in design procedure between a single-pulley drive and a dual-pulley drive only starts with the determination of the tight-side and slack-side tensions, T_1 and T_2.

Typical design of dual-motor conveyor.

For our typical example we are going to use the design of one of three large belt conveyors carrying iron ore from the Screening Plant to the Ore Loading Pocket of an open-pit deposit in the Labrador field of Canada; the figures used are approximate only. We start with a listing of the known data layout dimensions:

Step (1). Known data for design.

(1) Belt width selected = 36 in.
(2) Belt capacity = 1,790 tons per hr. (TPH) of iron ore, minus 5½ in. lumps, weighing 140 lb. per cu. ft. Call this value W.
(3) Belt speed (fpm):

$$S = \frac{TPH \times 2000}{W \times A \times 60} = \frac{1790 \times 2000}{140 \times .70 \times 60} = 607$$

Here A = Cross-section loading area (sq. ft.) for a 36 in. belt riding on 20 deg troughing idlers.
(4) Horizontal shaft centres: L_H = 1000 ft.
(5) Total lift: H = 241 ft.
(6) Belt slope = 15°09′15″ = 3¼ in 12.
(7) Diameter of dual drive pulleys = 55¾ in. OD (of rubber lagging) × 42 in. face.

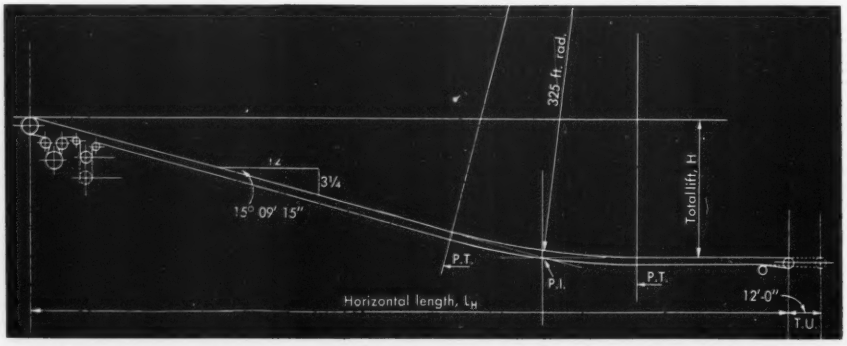
Step (2).

From the known factors and belt layout we determine the hp required at driveshafts (four components).

Instead of reading values from hp tables, we shall use the basic straight-line formulas expressing hp components. In these, the following symbols are used:—

F_1 = Friction factor for rubber belt riding on 6 in. diameter anti-friction idlers = .028 (from any belt design handbook).
F_2 = Friction factor for pull due to revolving idlers under a loaded belt and bending the belt over pulleys and idlers. This equals .035 for 6 in. diam. anti-friction idlers (from any belt design handbook.)
L_H = Horizontal length of conveyor = 1000 ft.
L = Actual length of carrying belt = 1030 ft.
Q = Estimated weight of belt and idler moving parts (lb. per linear foot of conveyor) from tables in manufacturer's handbooks = 44 (for a 36 in. belt).
T = Capacity, (tons per hr.) = 1790, from Step (1).
H = Total lift of material (ft.) = 241 from Step (1).
B = hp component for expressing effort to move idlers and belt

$$= \frac{Q \times S \times 60}{2000} = \frac{Q \times S}{33} = \frac{44 \times 607}{33} = 809$$



2. Elevation diagram showing complete 36 in. belt conveyor with dual motor drive at the upper left, 325 ft. radius curve and second take-up lower right. The tail pulley consists of pillow blocks bolted to the support beam and can be moved when belt slack develops.

e = Factor for additional hp to move material on belt, independent of its length = .002.
h = Factor for additional hp to move conveyor belt, independent of its length = .004.

First Component (hp required to drive the empty conveyor belt): The formula for this component is the sum of two factors. The first represents the power required to move a given length of belt over the idlers; the second a fixed amount of power which is independent of the length of the belt.
This formula, hp (1), can be expressed as follows, using the factors tabulated above:

$$hp(1) = \frac{F_1 \times Q \times L \times S}{33{,}000} + hB$$

Since $B = \dfrac{Q \times S \times 60}{2000}$ (see above),

$$Q \times S = \frac{B \times 2000}{60}$$

$$\text{Thus, hp (1)} = \frac{F_1 \times \dfrac{B \times 2000}{60} \times L}{33{,}000} + hB$$

$$= .001 \times F_1 \times B \times L + hB$$
$$= (.001 \times .028 \times 809 \times 1030) + (.004 \times 809) = 26.57$$

Second Component (hp required to move material horizontally): The formula for this component is also the sum of two factors. The first represents the power required to move a given load of material over a given length of belt; the second a fixed amount of power which is independent of the length of the belt.
This formula, hp(2), can be expressed as follows, using the factors tabulated above:

$$hp(2) = \frac{F_2 \times T \times 2000 \times L \times S}{33{,}000} + eT$$

As the capacity of the belt given above in TPH is expressed as lb. per linear foot of belt and the belt speed (ft. per minute),

$$\frac{T \times 2000}{S \times 60} = \text{load per linear foot of belt (lb.)}$$

$$hp(2) = \frac{F_2 \times \dfrac{T \times 2000}{S \times 60} \times L \times S}{33{,}000} + eT$$

$$= (.001 \times F_2 \times T \times L) + eT$$
$$= (.001 \times .035 \times 1790 \times 1000) + (.002 \times 1790) = 66.23$$

Third Component: hp required to elevate 1790 TPH a height of 241 ft.

$$hp(3) = \frac{T \times H}{990} = \frac{1790 \times 241}{990} = 433.9$$

Fourth Component: Additional hp for overcoming friction losses at drive and snub shafts is assumed to be 5% of total of above components.

$$hp(4) = \frac{5}{100} \times (26.57 + 66.23 + 433.9)$$
$$= 26.30$$

Total net hp required = 553 approx.

Type of drive	Pulley surface	Angle of wrap (deg.)	Ratio T_1/T_2
Single drive pulley without snub	Bare iron	185	2.24
	Rubber-lagged		3.10
Single drive pulley with snub	Bare iron	220	2.61
	Rubber-lagged		3.83
Two drive pulleys. Snub on both sides of secondary	Bare iron	420	6.25
	Rubber-lagged		13.00

Step (3).
Determine the effective belt tension (T_E).

$$T_E = \frac{hp \text{ (net)} \times 33{,}000}{S} = \frac{553 \times 33{,}000}{610}$$
$$= 30{,}040$$
T_E = 30,000 lb. (say).

Step (4).
We select a total angle of wrap around the 2 drive pulleys of 420 deg. Assuming the practical minimum angle of wrap around either pulley to be 180 deg., the total angle of wrap of 420 deg. could be proved by the following combinations:

	deg.	deg.	deg.	deg.
Primary pulley:	180	200	220	240
Secondary pulley:	240	220	200	180
Total	420	420	420	420

The relationship between effective tension and slack-side tension for various angles of wrap are read from tables as a Drive factor (K). They are obtained from the basic tension formula $T_E = T_1 - T_2$ and are expressed as:

$$K = \frac{T_1}{T_E} - 1 = \frac{T_1 - T_E}{T_E} = \frac{T_2}{T_E}$$

From tables read the following values:
For 180 deg. wrap, K = .50
200 " " , K = .42
220 " " , K = .35
240 " " , K = .30
420 deg. total wrap, K = .083
After two or three (or possibly more) trials to determine the amount of hp pull taken by the secondary pulley, (using various angles of wrap) we find that, by using 240 deg. wrap on the secondary and 180 deg. on the primary, the share of the total hp taken by each pulley comes below that of two commercial-size motors. Applying the correct factor (K) to the effective tension (T_E), we are able to solve for the slack-side tension (T_2) because

$$T_E \times K = T_E \times \frac{T_2}{T_E} = T_2$$

Thus, $T_2 = T_E \times K = 30{,}000 \times .083$
$= 2{,}490$ lb. or 2,500 lb, say.
$T_1 = T_E + T_2 = 30{,}000 + 2{,}500$
$= 32{,}500$ lb.
At this point we note that with 420 deg. total belt wrap, the tight-side tension (T_1) of 32,500 lb. is

only 8.3% more than the effective tension, (T_E) of 30,000 lb. required to move the fully-loaded conveyor. So the belt we select (which costs about ⅓ the total cost of the entire installation) need not be much thicker than one whose tensile strength will transmit the hp pull.

Step (5).

Determine the hp taken by both primary and secondary pulleys.

Tension (T_X) between primary and secondary pulleys is:

$$T_X = T_2\left(1 + \frac{1}{K_S}\right) = 2500 \times \frac{1.30}{.30}$$

$$= 10{,}833 \text{ lb.}$$

$T_X = 10{,}830$ lb. (say)

Effective pull in primary drive

$$T_{EP} = T_1 - T_X$$

$$= 32{,}500 - 10{,}830 = 21{,}670 \text{ lb.}$$

hp taken by primary drive

$$= \frac{T_{EP} \times S}{33{,}000} = \frac{21{,}670 \times 607}{33{,}000} = 398.6$$

Effective pull in secondary drive

$$T_{ES} = \frac{T_2}{K_S} = \frac{2500}{.30} = 8330 \text{ lb.}$$

hp taken by secondary drive

$$\frac{T_{ES} \times S}{33{,}000} = \frac{8330 \times 607}{33{,}000} = 150.02$$

Check: Total hp taken by both drives is:

$$398.6 + 150.02 = 548.62$$

Total calculated hp, from Step (2)

$$= 553.00$$

For the primary drive we select a 400 hp, 890 rpm (full load speed) wound rotor motor. Current available: 4160 volts, 3 phase, 60 cycle. For the secondary drive we select a 175 hp, 890 rpm wound rotor motor. Total hp supplied by both motors $= 400 + 175 = 575$

Step (6).

Check calculated or theoretical slack-side tension (T_2) against the required minimum slack-side tension of the conveyor, by figuring the various components starting at the tail end of the conveyor. It equals the assumed tail-end tension to maintain tautness in the belt and remove sag between idlers (T_{ET}) + belt slope tension ($B \times H$) minus one half return slope friction, ½ ($\times Q \times L$).

$$T_2 = T_{ET} + (B \times H) - \tfrac{1}{2}CQL$$

$$= 1000 \text{ lb. assumed} + (20 \times 234.5)$$

$$- \frac{.028 \times 44 \times 990}{2}$$

$$= 5080 \text{ lb. (say).}$$

The difference (D) between the calculated or theoretical slack-side tension and the required minimum slack-side tension (T_2) is 5080 − 2500 = 2580 lb. Since the effective tension to move the belt (T_E) is a fixed quantity of 30,000 lb. and since any amount added to the slack-side tension must also be added to the tight-side tension to maintain the relationship $T_E = T_1 - T_2$, the corrected tight-side and slack-side tensions for the conveyor belt being designed are:—

Corrected value of T_1

= Theoretical T_1 + Difference D

= 32,500 + 2580 = 35,080 lb.

Corrected value of T_2

= 5,080 lb. (as given above).

Check: Corrected T_1 − Corrected T_2 = 35,080 − 5,080 = 30,000 lb., the known T_E.

Step (7).

Determine the required gravity take-up load. This consists of the sum of the following weights: Take-up pulley; take-up shafts and bearings, etc.; take up steel framework; sand or ore ballast to be added. It amounts to: $P = 2 \times$ corrected T_2 $= 2 \times 5080 = 10{,}160$ lb.

To permit the design of the structural steel members for supporting the various shaft bearings and other drive equipment, we must now determine also the corrected value of the tension in the belt between the two drive pulleys (T_X).

Step (8).

Determine the actual belt tension (T_X) between the drive pulleys:

$$T_X = \frac{T_1 \text{ (theoretical)}}{K_1 \text{ (for 240 deg. wrap)}} + 2 \times \text{difference}$$

between actual and theoretical T_2.

$$= \frac{32{,}500}{4.33} + (2 \times 2580) = 12{,}665.8 \text{ lb.}$$ The value of 4.33 for K_1 (or T_1/T_2) was read from Table 1. This value of 12.665.8 lb. for T_X compares with the previous calculated value of 10,830 lb. in Step (5).

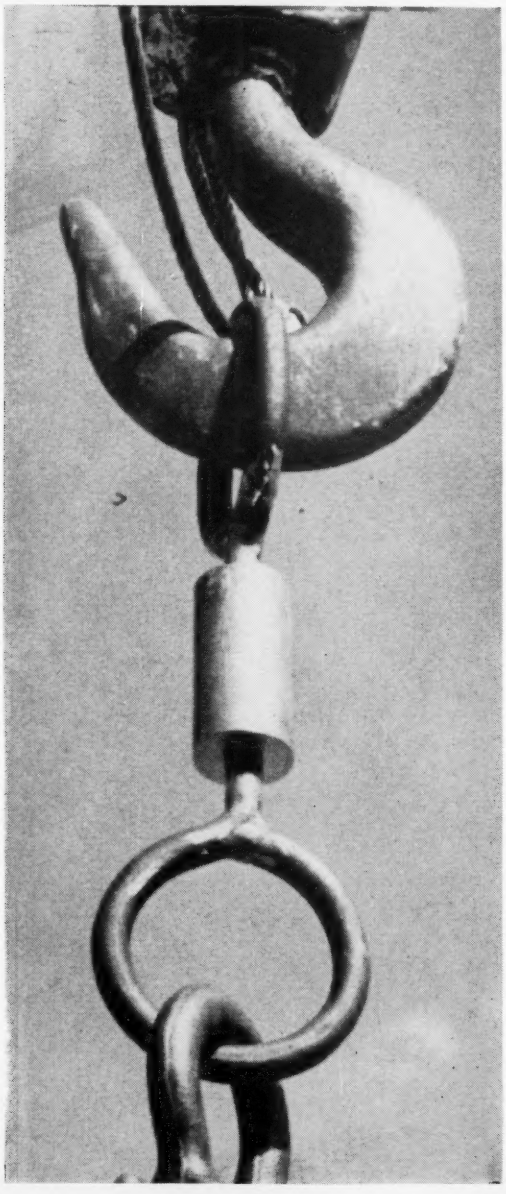
Summary of design

For our design, we end up with a 36 in. wide belt developing a maximum (corrected) tight-side tension of 35,080 lb. and an actual slack-side tension of 5,080 lb.; the maximum stress in the belt is only 17% higher than the effective tension (T_E) of 30,000 lb. required to move the fully-loaded conveyor. Moreover, the angles of wrap selected (180 deg around the primary pulley and 240 deg around the secondary pulley) permit the use of two commercial size motors: 175 hp for the primary drive and 400 hp for the secondary drive, without too much additional hp provided over the calculated amount. And the tight-side tension is almost 7 times as great as the slack-side tension, compared with ratios as low as 2.5 or 3.0:1 for single snub pulley type drives.

To provide a belt of 36 in. width that would meet a tensile strength requirement of 975 lb. per in. of width, it was necessary to select one with several plies of a special rayon fabric. This material has greater strength than cotton, with a lower weight and less stretch. But to provide the greater flexibility need for such a thick belt to trough in the carrying idlers, the transverse reinforcement is nylon fabric. This material has greater elongation than rayon or cotton and so it is not used for the longitudinal fabric which carries the belt tensions.

Above: Adhesive lifts 5,000 lb. after 30 minute set.

Below: Adhesion was between two 2 in. rods of steel.



Wonder adhesive from a routine test

An unexpected result during a routine test at the Research Laboratories of Eastman Kodak led to the development of a new liquid adhesive with a rapid set-time and high strength.

To demonstrate the effectiveness of the adhesive, place a drop of it on one end of a 2 in. steel rod. Press the end of a similar rod against this surface and hold for a few seconds. With eye-bolts attached to opposite ends of this assembly, place it between a crane hook and a lifting harness. Within 5 min, it will easily support the weight of a 200 lb millwright. Meantime, the bonding forces between the molecules are continuing to develop rapidly. Within 30 min the crane will lift a large automobile full of passengers, in all about 5,000 lb. If the adhesive were permitted to set for 48 hr three identical cars could be lifted simultaneously.

All this is accomplished without the need for heat, pressure, evaporation of solvent or long curing times. The adhesive action (it is the result of the polymerization of a cyanoacrylate monomer) works well with a wide variety of materials including metal, glass, wood, ceramics, rubber, plastics, cork, felt, leather, cardboard, porcelain and even the human skin.

Among the plastic materials to which the adhesive has been successfully applied are cellulose acetate, cellulose acetate butyrate, styrene, polyester glass laminates, phenolics, epoxies, acrylates, urethanes and vinyls. Among the metals tested, combinations of steel, aluminum, copper, magnesium, bronze and brass can be bonded effectively.

Eastman anticipates that industrial applications for the adhesive will develop where: (1) extreme speed of setting and curing is needed; (2) where it is necessary to bond like (or unlike) materials that do not normally respond to conventional adhesives or cements, and (3) where there is need for high bonding strengths within the confines of small joining surfaces, as in miniature assemblies of intricate design. Thus, the combination of properties of the compound (known as Eastman 910 adhesive) may bring an entirely new approach to the use of adhesives in design and production fields.

The rapidity with which strong bonds are formed depends on the nature of the materials being bonded. Tests have shown glass-to-glass bonds to be unbreakable within 5 to 15 sec. Wood-to-wood bonds require from 3 to 5 min to set and only 2 to 3 hr before the bond can withstand rough handling. Steel-to-steel bonds set in 15 to 20 sec, develop 2,000 psi tensile strength within 30 min and 5,000 psi after 48 hr. After a cure of several weeks, the tensile strength increases slightly.

Among the conditions that weaken or destroy the bond formed by the adhesive are prolonged exposure to high humidity and temperature. Exposure to temperatures above 212 F for 24 hr will destroy it. ★

D. M. Duncan*

Making a choice of dust collectors

Dust elimination has graduated from the luxury to necessity class

Today's constant search for higher quality and lower costs is making the dust collector as basic and important an item of industrial equipment as the saw or the grinder. Elimination of dust is no longer thought of as a luxury, but as a necessity in efficient shop operation.

The advantages of effective dust control can be divided into three broad categories:

(1) to prevent damage to the machine or product. Dust shortens machine life and efficiency with its clogging or abrasive action. Dust can also damage the fine surfaces of products.

(2) dust control increases worker efficiency. Not only is dust often injurious to employees' health but the annoyance factor alone reduces the effectiveness of shop personnel.

(3) dust is often collected for the sake of the dust itself. Diamond and tungsten carbide dust, for example, can be salvaged by using special collectors and sold for reprocessing with considerable economy.

In cold figures, savings are often impressive. Torit Manufacturing Company (makers of unitized type dust collectors) report that one automotive firm recently recovered the total cost of their diamond dust collectors in 21 working days, through the salvage and resale of dust from the diamond grinding wheels. Other manufacturers have stated that their collector-equipped grinders need regrinding and alignment only 1/5 as often.

There are two basic concepts of dust collection. One is the central system with centrally located fans and ducting to the various machines. Central system collectors are a permanent, "built-in" part of the plant.

★ *Torit Engineering Represenative, Duncan Machinery Co.*

The unitized principle, on the other hand, fits one dust collector to one machine or to a small group of adjacent and similar machines. Its more obvious advantages are:

Flexibility. A unitized collector can be moved to new locations with the machine. When the plant expands, new collectors can be added as needed.

Performance. Individual collectors can be tailored to the volume and character of the job they must perform.

Economy. Unit installation costs are far lower, usually about one half. Operating costs are lower since collectors are in operation only when the machines they service are running.

Heat is saved because filtered air can be exhausted indoors.

Safety. Fire hazards from sparks are eliminated since lint from buffing operations can be kept separate from grinding dust.

Unitized collectors, too, can be divided into two basic types: the cabinet cloth filter types and the cyclone separator types.

Most widely used of the individual collectors are the cabinet cloth filter models. These are compact, self-contained units for use with grinders, sanders, metal saws or in any application where gritty dust must be removed.

In operation, the dust-laden air is drawn into the cabinet from hoods surrounding the grinding wheel or other dust source. Heavy particles fall immediately into a dust tray under the filters. Finer dust particles are trapped on the outer, under side of the filters. Most of these particles, too, fall into the dust tray when the machine is stopped. The remainder is shaken loose by a handle from outside the cabinet. Only occasional brushing of the filters at regular intervals is necessary to keep the machine at top operating efficiency.

The filtered air passes upward through the cabinet, cools the motor on its way and is discharged directly into the room.

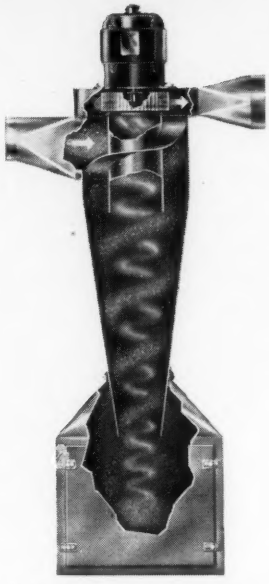
These cabinet units may be used with either grinding or buffing wheels, but separate collectors should be used for each type. Sparks from grinding operations may otherwise ignite lint from rag buffing or polishing wheels and start a fire. Cloth filter units are not recommended for use with rag wheels when buffing or polishing compounds are used, since sticky lint from such operations is apt to clog the filters to a point where the suction is inadequate.

Torit engineers recommend standard 3450 rpm motors for most dust collector installations. They develop the greater air velocity and static pressure desirable on most grinding, buffing and similar operations. Where a lower static pressure is satisfactory, 1725 rpm motors can be used, especially when quiet operation is a requirement.

Standard cabinet cloth filter units have operating capacities ranging from 160 to 2,000 cfm. Larger capacities can be achieved either by specially built units or by using several standard units in combination. The filters are of cotton cloth, finely woven, chemically treated and spark resistant.

Cyclone separator units, the other basic type of unitized dust collectors, are for use with buffing wheels or where large volumes of dust are created, as in woodworking. They are especially effective with buffing

Continued on page 57



The cyclone type is usually used with buffing wheels, when the dust volume is large.

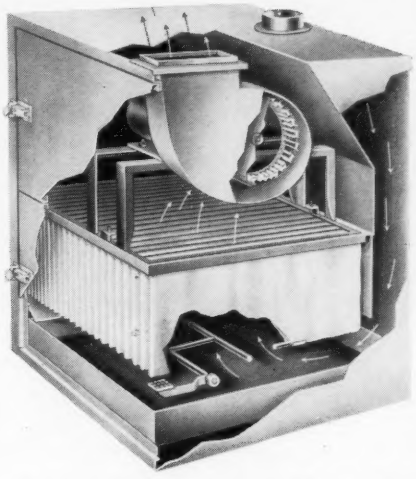
Cyclone type

SPECIFICATIONS

Model No.	Motor H.P.	Motor R.P.M.	Inlet—one only Diam. inches	Inlet—one only cfm	Inlet—one only Air Speed fpm	Inlet—one only Static press inches (water)	Ship Weight lb.
FM Units for outdoor exhaust							
12FM	½	3450	3	280	5700	4	245
13FM	¾	3450	4	520	6050	3½	260
18FM	1½	3450	5	725	5300	3½	410
19FM	2	3450	6	1100	5650	2.7	440
219FM	5	3450	8	2100	6000	3	635
FB and FMA Units for indoor recirculation							
12	½	3450	3	260	5650	3.2	360
13	¾	3450	4	475	5500	3.0	380
18	1½	3450	5	700	5150	3.0	480
19	2	3450	6	1000	5500	2.5	510
219	5	3450	8	2000	5800	2.8	700

Fan Sizes

Model No.	Size, inches	Model No.	Size, inches
12	8¼x1	19	9-15/16x3
13 & 18	9⅛x1½	219	9-15/16x2



The cabinet type is most widely used when the dust needing removal is very gritty.

Cabinet type

PERFORMANCE DATA

Unit No.	One Inlet Operating Inlet Tests— Inlet Size in.	cfm	Static press inches (water)	Air speed fpm	Two Inlets Operating EACH Inlet Tests Inlet Size in.	cfm	Static press inches (water)	Air Speed fpm
52	4	250	1	3000	4	160	½	2000
54-54A	3	240	2¾	4800	...	...	...	....
62	..	...	...	....	4	250	1	3000
62	6	500	1	3000	..	...	...	....
64-64A	3	320	4	6500	3	250	3	5100
64-64A	4	500	3½	5700	..	...	...	....
66	3	370	4½	7500	..	...	...	....
75	3	350	4¾	7600	3	300	3¾	6600
75	4	500	3¾	5900	..	...	...	....
80	6	650	1½	3500	6	500	1	3000
80	..	...	...	....	4	300	1½	3500
81-81A	4	580	4½	6500	4	465	3	5300
81-81A	6	1000	3	5000	..	...	...	....
83	..	....	...	....	3	385	5¼	7800
83	4	700	5¾	8000	..	...	...	....
84	4	650	5¾	7500	4	525	4¼	6000
84	6	1100	4¼	6000	..	...	...	....
122	7	1500	3¾	5500	..	...	...	....

The throw-aways are shown above being set up for a multiple tool broaching application.

Machining with a "throw-away" insert

H. B. Iron, PRESIDENT, WESSON CUTTING TOOLS LTD.

Use of these inserts can make tooling an avenue for cost reduction

Probably one of the most important and rapidly moving developments in the last few years is in the field of carbide cutting tools in the form of "throw-away" solid carbide insert holders for machining metals. This new tool type is destined to have a positive influence on general metalworking practice.

Throw-aways embody the use of thin slugs of carbide. When used in specially designed tool holders or cutter bodies, they can be indexed up to eight cutting edges and after becoming dull, thrown away cheaper than they can be resharpened. The use of such tooling completely eliminates cutter or tool grind operations and costs.

This is the principal reason for the throw-away idea. Firms using automated facilities have learned that, as direct costs have been lowered, indirect costs have risen to a point where they reduce the degree of profit promised by such facilities.

One automotive executive put it this way recently: "The justification for automation is cost reduction, but it seems that after reducing standard hours by two-thirds, the 100% overhead rises to 300%."

Maintenance is the critical problem. Although this is true in varying degrees for the entire process, a large part of the higher maintenance costs is reflected in excessive down-time through tool failure, limited tool life and other tool factors. For this reason, manufacturers are looking to tooling as a prime avenue for indirect cost reduction. The new development of throw-aways is doing just that, whilst at the same time creating many production benefits.

Where before it might not have been economically feasible to mill a particular part, throw-aways (which can be indexed rapidly and eliminate the high cost of maintenance grinding) now make milling economically more attractive.

Again, where speed limitations might have ruled out milling in preference to broaching, throw-aways offer still another advantage. The use of these inserts in Wesson's new cutter designs makes extremely high feed and speed combinations not only possible on a production basis, but very practical.

To determine the extent to which the new tooling has taken hold in U. S. metalworking, Wesson conducted a national survey recently with startling results. It clearly shows what impact the new tooling concept has had on industry and how readily the idea is being adopted in the form of single point tools.

About two out of three companies identified with metalworking are currently using at least some single point tools fitted with throw-away inserts. Furthermore, in those companies throw-aways already present about a quarter of all single point tools.

This means that 16% of all single point tools used in metalworking today are already of the throw-away type, despite the fact that this tooling has been available only for a very short time.

This, however, is only the beginning, for the industry

study shows that close to three out of four companies in metalworking are currently planning to increase their use of throw-aways. This includes many companies not yet using them, of course.

Single point tool operations that will be switched to throw-aways shortly represent 35% of all single point tools in those plants and account for 24% of all single points used in metalworking today.

Actually, present plans in industry call for boosting the over-all use of throw-aways from 16% today to 40% of all single points in the next few years. Where they are used (and that means in 77% of all metalworking plants) they are expected to take care of 60% of all single point tooled operations.

There are two primary reasons, according to users, for this rapid increase in the use of throw-aways: (1) no sharpening and (2) reduced machine down-time through quicker tool changing.

The most extensive use of throw-aways today (the survey reveals) is in the field of transportation equipment, where 73% of the plants are using them. Next comes machinery (except electrical) with 70% of plants and ordnance with 67%.

The bigger the plant, the more likely it is to be using throw-aways. The biggest penetration has been in the ordnance industry, where the use has reached 33% of all single point operations. Transportation equipment follows with 21%. Other industries range from 9% to 15%.

In plants reporting planned step-ups, the average increase ranges from 49% of single point tools in the non-electrical machinery plants down to 20%-25% for plants in such fields as fabricated metal products.

The larger the plant, the greater the interest in the concept of throw-aways for milling and other types of tooling. Industry-wise, the most promising plants for milling are in the ordnance field (82%).

That interest should be greater for throw-aways in multiple point tools seems logical, since the problems and costs of grinding such tooling are multiplied many times over single points.

Important also is that the new tooling is readily adapted to the new high velocity machining materials (such as ceramics and cemented oxides) that promise to boost machining speeds two or three times above the present limits, and provide greater tool life.

Important, too, is the fact that this form of tooling is precipitating the trend toward practicability and feasibility of automatic tool changing. While this is still in the experimental stages, rapid strides are being made toward completely automatic direction electronic tool feeding devices that will compensate automatically for tool wear and automatically change tools when dull.

What is more important in current practice, however, are the benefits being derived on the non-automatic side, where there is a growing use of pre-ground and pre-mounted tools inventoried right at the machines where they can be inserted without trips to the tool crib and without setup delays. Such tooling as the "throw-aways" hasten and make this trend possible. No skill is required to index the inserts from a dull edge to a sharp one.

In the Wesson Multicut holders, a few turns with an Allen wrench loosen the clamping screw and the insert is indexed or replaced in a matter of seconds. With this form of tooling, it is not necessary to remove the entire tool from the machine (necessitating a new "setup" with each change).

In addition to cost advantages enjoyed with throw-away tooling, certain application advantages manifest themselves in a number of designs.

This tooling is currently being used to form an internal spherical radius of an automotive differential case and holding extremely close limits on the radius to with ±0.001 in. What is more, this is held automatically upon indexing or replacing of the carbide insert. The variations in precision grinding common to human error that were experienced with former tooling (which required regrinding of dull edges) are now eliminated.

Employed in milling cutters, the thin throw-away inserts have tremendous ability to take "heavy" feeds, depths of cut at extremely high speeds.

On one operation, for example, being run on a production basis, a 6 in throw-away insert cutter is machining 0.30 carbon steel taking a ½ in. depth of cut at 25 in. feed at 1450 SFPM! On this particular operation, the cutter is producing 46 pieces per index, where previous cutters produced only 17 to 19 pieces. It produces a required 63 M.U. finish in one pass, while old cutter-types had to take two cuts to obtain the same finish.

By incorporating the principle into boring tool designs, many precision and maintenance problems have been solved. Typical is the adaptability of the throw-

Know your manufacturing methods

One of the most important factors in the success of a manufacturing enterprise is the design engineer's knowledge of manufacturing methods. It is this "know how" that enables him to translate his designs successfully and profitably into a finished product.

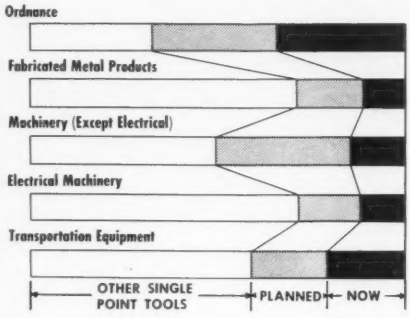
In an age of increasingly greater specialization, it is more and more difficult for product designers to acquire this manufacturing knowledge and to keep abreast of the constant changes taking place in production methods. So rapid is the evolution in tool technology!

Production know-how is important to the design engineer, not only for the degree of success he is to attain with his design profitwise, but for constantly improving the quality and performance of the finished product.

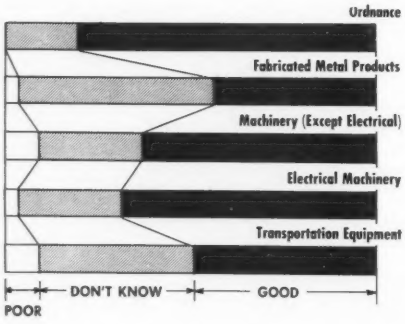
In the early days of mass production, it was a simple matter to design and process for production; almost all product designers had a background of production experience. In many cases, the chief production supervisor was also the chief product engineer.

Not so today. For this reason, product engineers must constantly appraise current production processes and methods (especially as they relate to tooling), for it is a foregone conclusion that design determines the tooling and the methods to be employed in production.

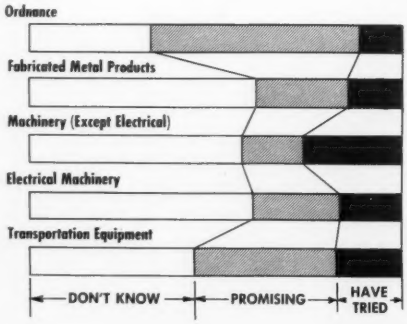
Single point inserts in use

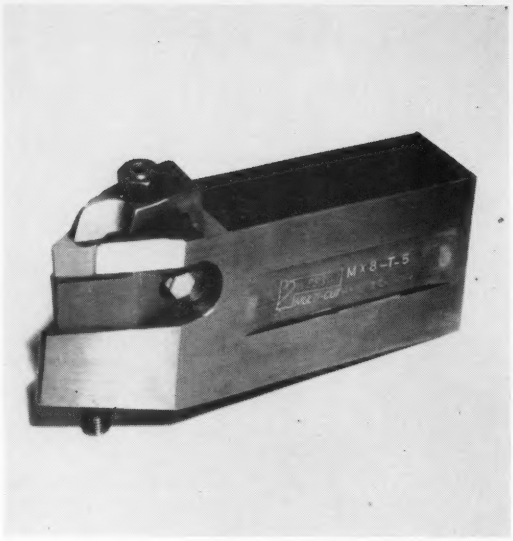


Future outlook for inserts



Application in other types





A slug-type insert holder used predominantly in industry which is giving ground to the throw-away type.

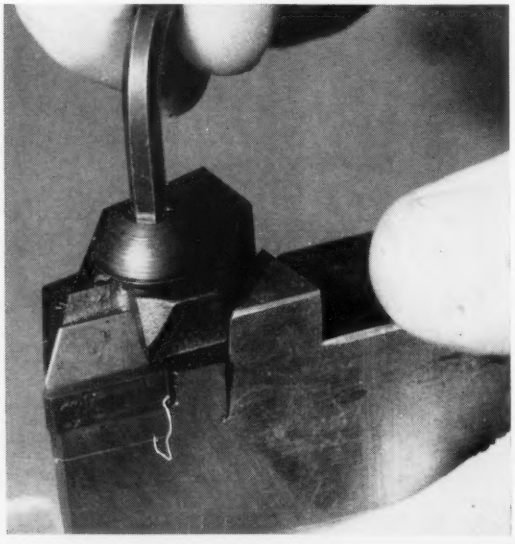
away idea to a micro-adjustable boring bar.

Such tooling (whether in the form of single point tools or multiple point tools) is greatly simplifying over-all tool design and virtually eliminating the need for high degrees of skill in maintenance.

Generally, the new tooling represents a tangible and effective method of reducing the cost of manufacture. In many cases, the reduction is significant.

To better understand the immediate effect of this tooling on general practice, it seems helpful to speculate on how it will contribute to the achievement of the "pure production" facility of the future.

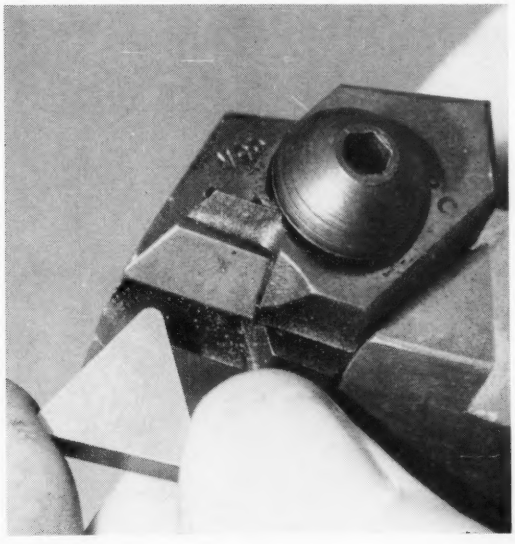
To index from a dull to sharp edge in seconds, it is only necessary to loosen the locking screw . . .



It will be recalled that, immediately prior to the last war, most plants equipped every three or four production machines with a tool grinder. When tools became dull, the operator merely shut down the machine, removed the tools and walked to the grinder and sharpened them himself.

The next step in improving production (as well as costs) was the removal of all such grinders to a central tool and cutter grind area where a group of trained grinders sharpened all the tools used in the plant. As the cost of such skilled grinders has risen (coupled with the increasingly larger number of tools that come into the plant as a requirement of more mechanized facilities), the costs of such maintenance have become excessive.

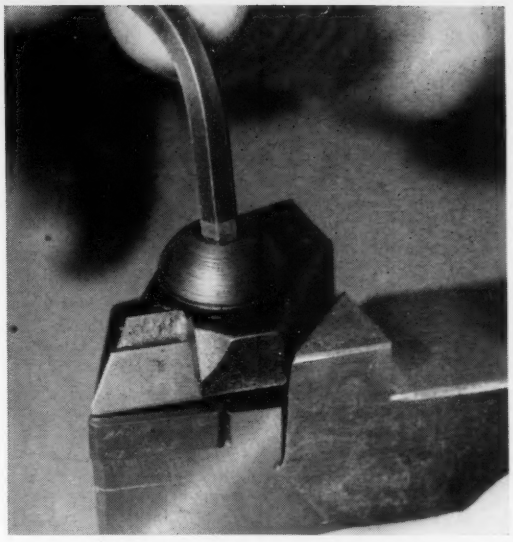
. . . turn the carbide tip to expose a new edge . . .



The new concept has the earmarks of a real solution. By incorporating such tooling on original equipment and on a planned replacement basis, it will not be necessary to add to grinding facilities and eventually may reduce them. In many cases, they may be virtually eliminated.

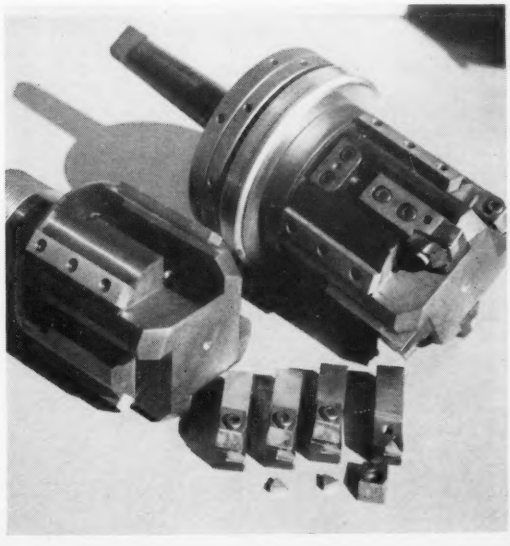
In the final analysis, this much is certain. Tool costs with throw-away inserts are dropping rapidly. Tool technology is advancing by leaps and bounds and the benefits to be derived from such new concepts is limited only by the imagination of the production engineer.

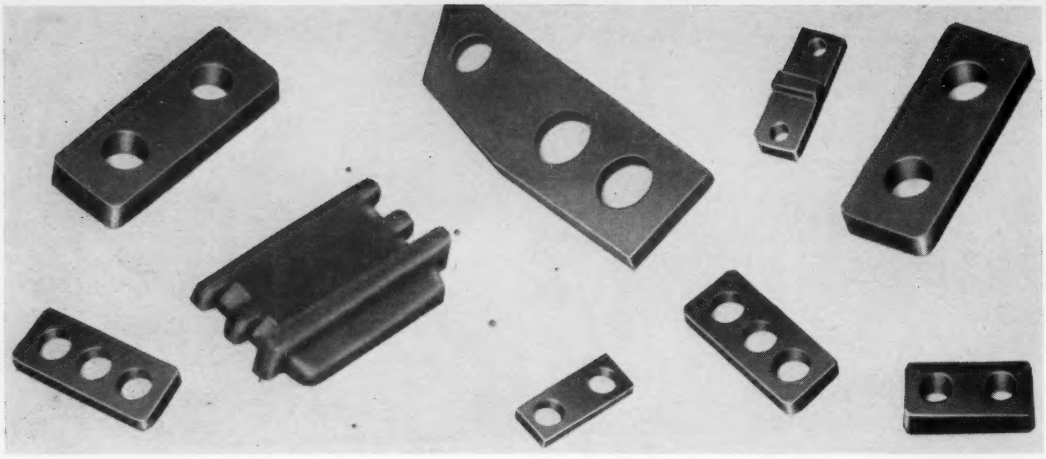
For the design engineer, such advancements represent changing methods, the advantages and benefits of which he must constantly be aware of. If the product engineer is to seek a constantly improved product, and following the trend to greater complexity, the practicability of such design progress will be greatly enhanced by the practicability of the tooling required to produce it. Throw-aways are proving a valuable answer. ★



. . . and then tighten down the clamp locking screw.

A variety of boring tools using throw-away inserts.





1. The Supramica 500 ceramoplastic relay spacers have no measurable moisture absorption and will not swell.

Ceramoplastics—successor to micas?

Mica's outgassing at high temperature opens the ceramoplastic field

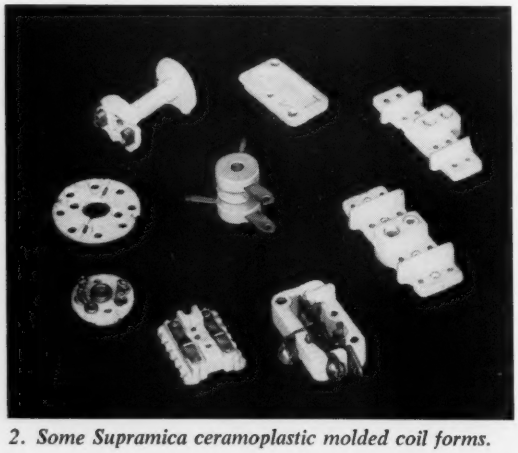
J. H. DuBois MYCALEX CORP. OF AMERICA

The choice of material for a relay lies basically between the organic plastics, the ceramics and the ceramoplastic materials.

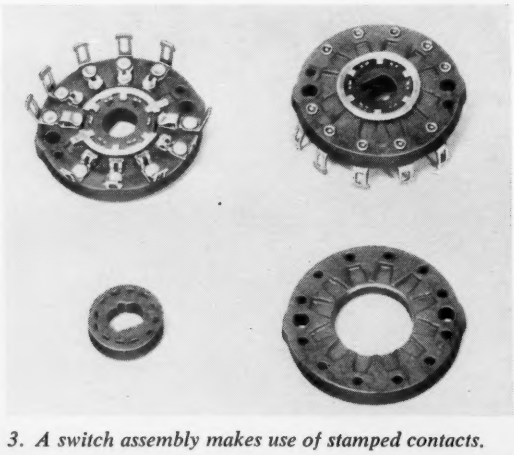
The **organic plastics** in general exhibit excellent moldability, the inclusion of complex insert assemblies, good dielectric strength, fair dimensional stability and poor arc resistance, combined with fairly low production cost. Of all the organic plastics, polytetrafluoroethylene is the only material that can be considered safe when exposed to real power arcs. Unfortunately, however, it releases fluorine at elevated temperatures and this often limits its use.

Ceramic materials, such as steatite, forsterite and alumina (which are basically metallic oxides that have been fired or matured at high temperature), are totally stable dimensionally, high in arc resistance, free from

Mica is commonly used in relay construction, especially in thin sections for high temperature and vacuum applications. It may however, be necessary to discontinue the use of natural muscovite mica in sealed high temperature relays, since outgassing at high temperature results in erratic performance and the presence of undesirable gases in the sealed chamber. Any special factors likely to cause trouble in relay operation, should be given consideration. Mechanical failure due to vibration, shock or other factors must be anticipated by the product designer and counteracted by careful material selection, adequate reinforcement and safety factors.



2. Some Supramica ceramoplastic molded coil forms.



3. A switch assembly makes use of stamped contacts.

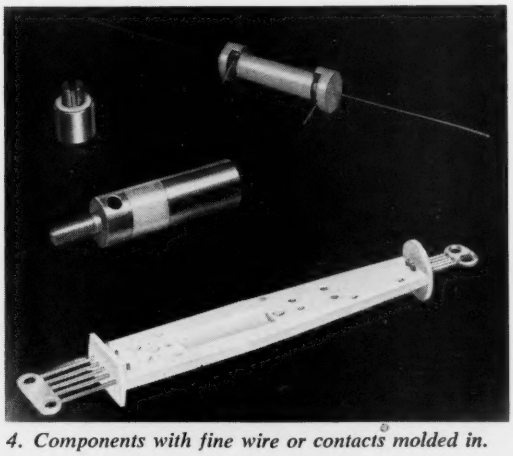
moisture absorption and unaffected by nuclear radiation. They are pressed to shape and fired after molding, so it is impossible to achieve close dimensional control or to use metal inserts and thus provide highly functional components. No metal reinforcement can be introduced to compensate for their low impact strength. When ceramic materials can be used in the "as fired" state, they offer the most economical solution for these critical applications.

The **ceramoplastic materials** and glass-bonded mica possess many of the best features of the plastics and the ceramics. They are thus very suitable for critical applications requiring absolute dimensional stability, the inclusion of metal inserts, arc resistance, resistance to radiation effects, complex functional design, freedom from corona effects and outgassing of deleterious vapors when operated at elevated temperature in high altitude or vacuum applications. A new ceramoplastic material, Supramica 560, is now available for 500 C (932 F) components. No distortion under load is observed at this temperature, and an important factor in the success of this new material for relay applications results because its thermal expansion coefficient closely matches that of nickel, steel and other insert materials.

This permits intimately bonded and permanently anchored metal inserts for highly functional designs and intricate sections, where success depends on the match of the metal and the ceramoplastic material at all temperatures (see Table).

Of great value, also, is the fact that the ceramoplastic materials are totally resistant to high current arcs, such as those experienced under short-circuit conditions in an aircraft, where the entire output of the generator may flow into the arc, completely carbonizing and destroying the phenolics, melamines, epoxys, alkyds or other organic materials commonly used.

For several years, conventional glass-bonded mica has been used for relay spacers in order to obtain complete dimensional stability under the effects of thermal differentials and high moisture environmental conditions. Supramica 500 ceramoplastic relay spacers (Fig 1) have no measurable moisture absorption and there can be no swelling of the spacers to cause contact displacement as the result of prolonged exposure to high moisture conditions. A secondary gain results from the matching thermal expansion coefficient; steel screws maintain the same degree of tightness at all times, so the spacers don't become loose as a result of thermal differentials. This is commonly experienced with the lami-



4. Components with fine wire or contacts molded in.

Thermal expansion coefficients for plastics, ceramoplastics and insert metals

	10^{-6}/deg C
Electrical glass	0.8-13.0
Porcelain	5.0
Silicone-glass laminate	5.0-10.0
Steatite	8.6-10.5
Platinum	8.8
Illium R	9.2
Mycalex 410 glass-bonded mica	10.0
Polyester-glass	10-30
Type 446 stainless steel	10.5
Supramica 555 ceramoplastic	11.2
Inconel	11.5
Type 430 stainless steel	11.8
SAE 1010 steel	12.1
Nickel	13.0
Monel	14.0
Type 18-8 stainless steel	16.0
Copper	17.7
Nickel-silver	18.0
Red brass	18.8
Mica-filled phenolic	19.0
Silver	19.1
Melamine-asbestos filled	20-45
General purpose phenolic	30-45
Alkyd-mineral filled	35.0
Polymonochlorotrifluoroethylene	45.0
Polystyrene	60-80
Polytetrafluoroethylene	99.0
Nylon	100-150

Properties of Supramica 560 ceramoplastic

Dissipation factor (1 megacycle)	0.0035
Dielectric constant (1 megacycle)	6.8
Loss factor (1 megacycle)	0.024
Volume resistivity (ohm-cm)	5×10^{13}
Specific gravity	2.8
Maximum operating temperature (deg F)	
Continuous	932
Short time	1112
Water absorption (% in 24 hr)	nil
Hardness, Rockwell M	125
Thermal expansion (/degree C at 20 deg C)	13×10^{6}
Flexural strength (psi)	15,000
Arc resistance to power arcs	Very high

Radiation resistance: Will withstand dosage of 3.7×10^{18} gamma photons per sq cm and 1.7×10^{17} fast neutrons per sq cm with no dimensional or hardness change.

5. Assembly with Supramica ceramoplastic molded in.

6. One surface of the relay part is a metal stamping.

7. A reinforced Supramica 555 ceramoplastic housing.

Ceramoplastic insulation continued

nated phenolic spacers used for telephones and other less critical applications.

One of the most difficult problems confronting the designer of high temperature and high reliability relays is the bobbin for the coil. Fig 2 shows a completely molded coil form held to very close dimensions and with the mounting and assembly holes included during the molding operations. This bobbin, designed for high temperature work, withstands continuous operation at temperatures over 500 C when molded of Supramica 560 ceramoplastic.

Fig 9 illustrates the draft and dimensional control required for bobbins of this character. This design guide has been worked out very carefully for maximum value at minimum cost in relay bobbins. An alternative construction is that in which the bobbin insulation is molded directly on a steel armature (Fig 10) to obtain thinnest possible insulating section and ensure maximum magnetic force. Another acceptable bobbin construction (Fig 11) makes use of a non-magnetic stainless steel tube for the barrel, with end flanges molded directly to the tube in order to produce a bobbin with no central barrel insulation.

The Elgin Neomite relay (Fig 8) illustrates another type of problem found with very small relays. This well-known product is a single pole, double-throw relay mounted in a transistor can.

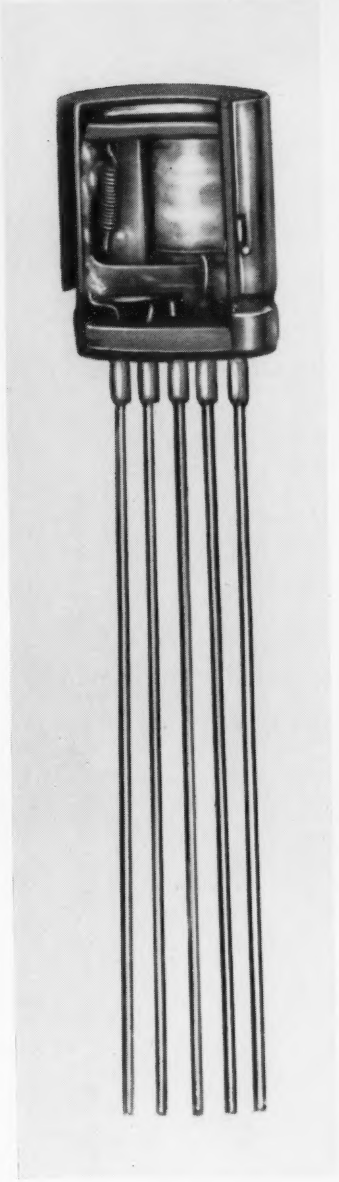
Unusual dimensional accuracy is essential for accurate assembly and freedom from binding or other malfunction factors resulting from mis-match of the assembly components. The closely toleranced base for this relay is molded of glass-bonded mica material in a multiple cavity mold to the exacting dimensions needed for this precision application.

Figs 5 and 6 show a circuit breaker assembly with a type of construction that is also being used in the development of new sealed relays. One surface of this molded part consists of a metal stamping with an inner molded shell of glass-bonded mica.

Terminals may be soldered in the holes protruding through this shell, and the contacts are mounted in the triangular box barrier which confines the arc to an area that is totally arc-resistant. Grooves along the side permit the accurate location of other functional components, and a metal case is soldered on the base after final assembly, to make it gas-tight. Whilst it is not possible, at present, to mold the ceramoplastic materials and metals together with a true hermetic seal, bonds of this type will withstand nominal pressures and are better than some of the so-called hermetic seals. The addition of silver paste fired around the terminal and bonded to the insert and the ceramoplastic (plus additional soldering operations) may convert these products to hermetically sealed units. Tin-indium solder has been used successfully for high temperature and high pressure seals of this type between metals and ceramoplastics.

Shown in Fig 2 are terminals assembled on the contact plate for a new relay. These contacts are attached after molding by a spinning operation, with a high degree of tightness. Metal terminal inserts of various types can be incorporated in the end flanges during the molding operation or assembled by a spinning operation after molding. Inserts of steel, silver, inconel, red brass or copper are often used. In many cases it is cheaper to mold the inserts in place, and complex multiple contact terminals may be included, as shown in Fig 4.

Continued on page 59



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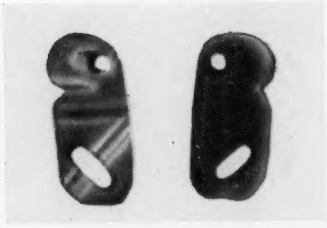

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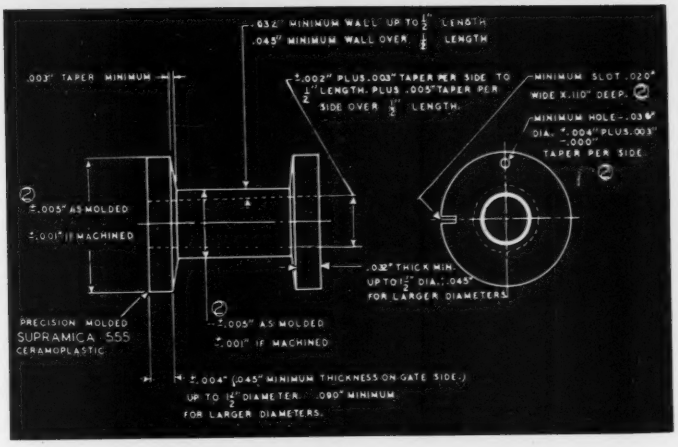

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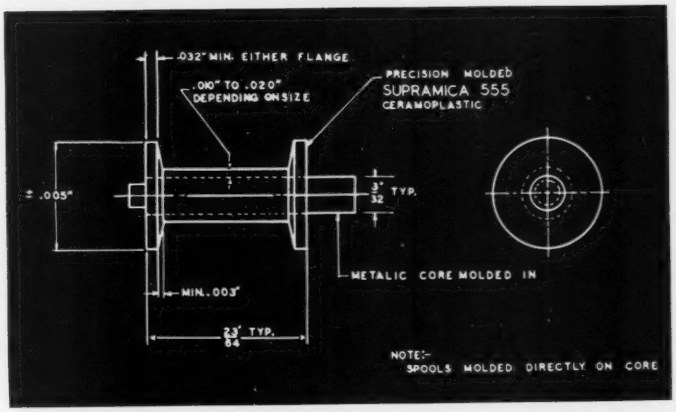

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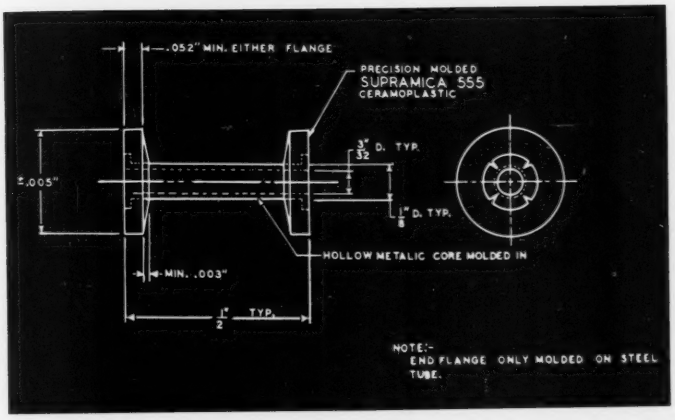
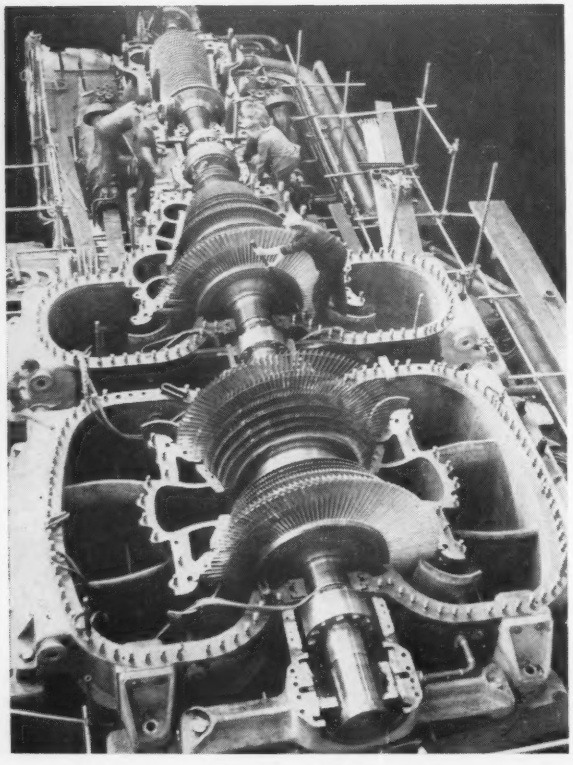


11

8. Base of this relay is molded of glass bonded mica material in a mold having multiple cavities.

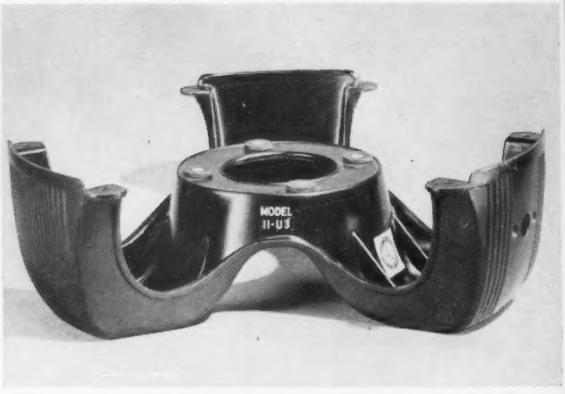
9. Draft and dimensional tolerances for molding; 10. Molding ceramoplastic directly to armature; 11. Barrel with non-magnetic molded flanges.

Design news in pictures



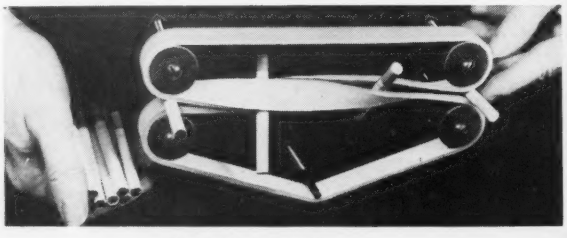
Atom plant turbine

This partially assembled turbine sits in the testing plant of Brown Boveri in Baden, Switzerland. It is a 150 MW three cylinder, triple exhaust condensing steam turbine and will eventually be in service in an European atomic plant. (200)



Basis for a breeze

Somewhat of a "whatizzit," this object forms the base of an electric hassock fan. Superior strength properties of BMG-5000 (Bakelite) are used for the base, which can support up to 20 times its own weight. (201)

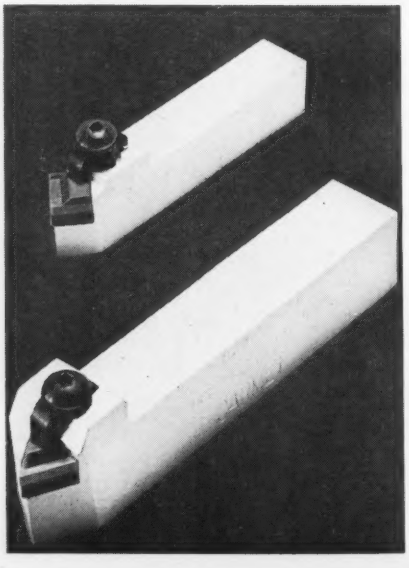


An end-over-ender

Cigarettes at Winston's Salem plant are made two cigarettes long with the filters in the middle and then split. This cunning urethane foam belt turns one bank over so that filters are same end for packaging. (202)

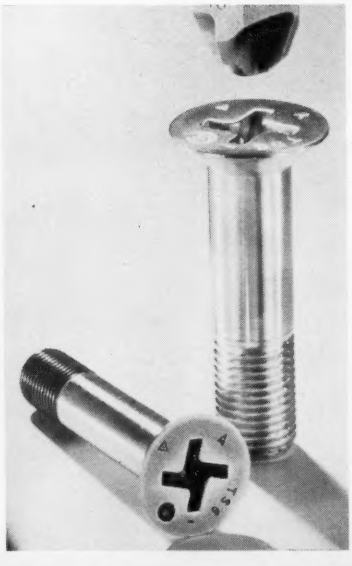
Toolholder

Left: Sample of a new style of tool holders now distributed. Note the "throw-away" inserts mentioned in this issue. (203)

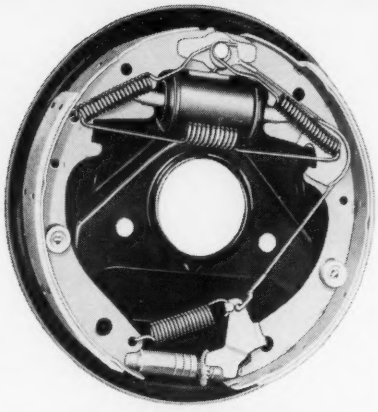


Torque recess

Right: Slip-proof recess in an aircraft screw sends the whole tightening force down the central axis of the screw. (204)

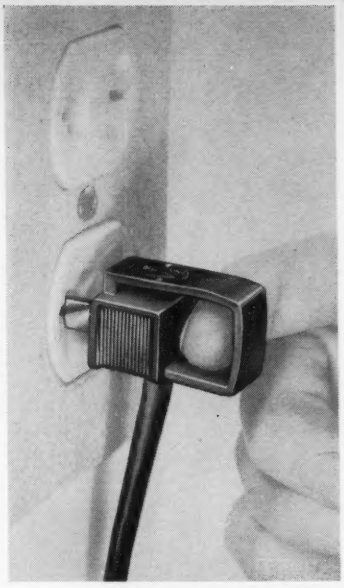


Some modern designs making news today



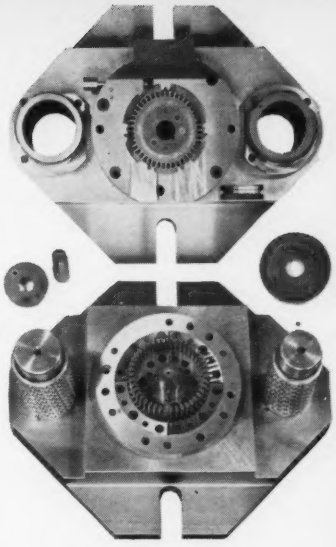
Edsel's automatic adjuster

Spring-loaded lever at bottom pushes the jacking screw around a notch at a time whenever, in result of the lining wear, brakeshoe travel becomes excessive. (205)



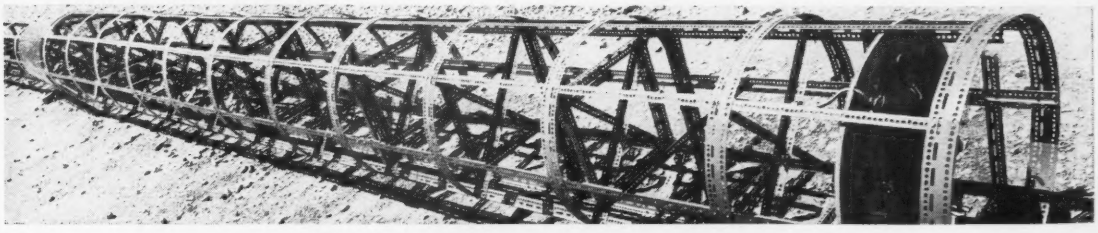
Finger pull

The molded handle allows this plug to be pulled out of the wall without damage to the cord. Excessive cord tucks neatly in the loop. (206)



Cemented-carbide

Product of CGE's new cemented carbide plant in Toronto is this complex lamination die used in the manufacture of electric motors. (207)



Skeleton of the Sputternik

When Toronto's Royal Ontario Museum needed a life-size model of the US Vanguard for an outdoor display pointing up the International Geophysical Year, Dexion of Canada donated the materials and constructed the rocket for them. The 72 ft. model, less than 1/22nd the weight of the real thing, was assembled in six 12 ft. sections. (208)

See-through roof

We can do no more than tell our readers that this car has a transparent roof and was used when the Queen visited Canada. The text is mislaid.

Ideas round-up

Fuel injection: a new task for electronics

The wizardry of electronics enables Chrysler Corporation's new fuel injection system to shatter the warm-up barrier to give motorists instantaneous engine response. Only limited production of the system is planned.

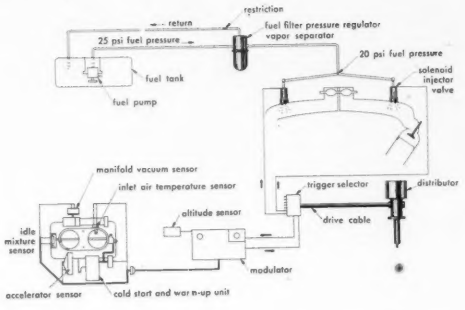
Along with super-fast warm-up, the fuel injection unit has increased the fuel economy, according to extensive laboratory and road tests. Precise electronic control provides for optimum distribution of fuel to the cylinders and greater efficiency.

The Chrysler fuel injection system differs from others in that the gasoline is portioned out by electrical pulses rather than by a mechanical metering device.

The "brain" of the system is about the size of a 3 x 5 in. file card box, which houses a transistor-equipped electronic modulator.

Located in front of the radiator, this electronic brain receives electrical signals from various sensory units mounted in and around the engine. These signals (reporting such variables as engine temperature, throttle position, air temperature, engine load and altitude) are instantly and constantly translated by the brain into the precise fuel requirements of the engine, whether it is idling, climbing or descending a mountain, cruising on the open highway or moving in stop-and-go city traffic.

The brain lengthens or shortens an electrical pulse according to this information. Each pulse is then sent out to open the injector valves for just the right length of time to allow the proper amount of fuel to be metered to the cylinders.



Schematic diagram of the new fuel injection system.

The frequency of the pulse is determined by engine speed, so that fuel is injected on each power stroke. The length of the pulses can be controlled to 1/1000 sec.

Gasoline is pumped from the tank into pipe-lines which travel along the top of the engine to serve both banks of cylinders. A key part of the fuel supply system is a new electric-motor-driven fuel pump submerged in the gasoline tank.

As a precaution against flooding, the fuel pump motor will not start until the engine is being started and will not operate when the engine is stopped. (210)

Weather stripping: it needs no cement for a perfect seal

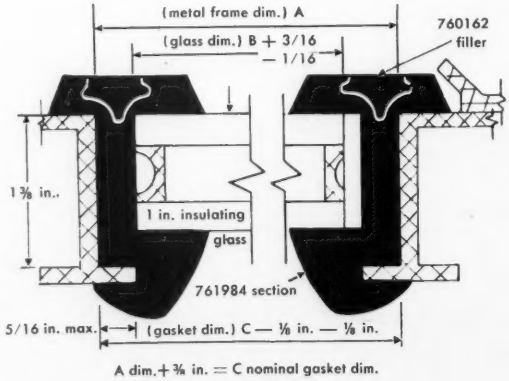
Available to Canadian builders and sash manufacturers is a new, simple, positive, leakproof setting member for glass, metal sash and spandrel panel components, and for all materials used today in modern curtain-wall construction.

Inlock self-sealing weather stripping is the product of 25 years' experience (by the Inland Manufacturing Division of General Motors Corporation) in the compounding of flexible setting members for automotive windshields.

This new weatherstrip, made of neoprene, needs no binders or cement to provide a weatherproof seal. The permanently waxed blooming surface will not deteriorate through exposure and no painting or finishing is required.

Danger areas formerly found around mitered corners and joints are eliminated because of the injection molded corners. The entire perimeter of every Inlock structural weather strip is fused into an error proof continuous cushion-sealed setting for every pane of glass, sash or panel.

Installation takes only a few seconds: mount, insert and zip, it's permanently pressure sealed. Replacement of broken glass or damaged panels is quickly carried out. (211)



Chemical milling: demonstration of its great potential

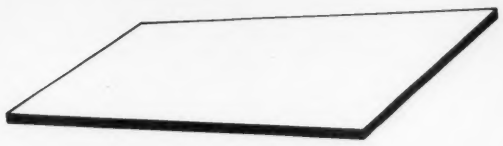


Fig 1

Fig 2

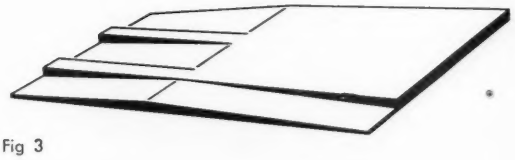


Fig 3

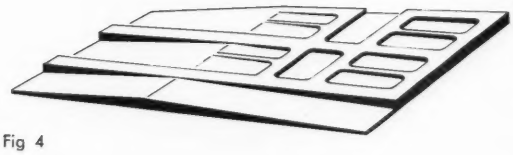


Fig 4

The most complicated part so far formed by the new manufacturing technique of chemical milling (see Design Engineering, October 1956, page 35) is in quantity production at United States Chemical Milling Corporation.

Involving three different taper angles, the desired shape requires nine different milling steps. After the plate has passed through staging and been thoroughly cleaned (Fig 1), a coating of maskant is applied. This coating restricts the removal of the metal to the exposed areas. After masking, the area in which the first cut is to be made is scribed with a sharp tool and then the maskant is stripped from the area to be milled. Following this, the first cut (which is a taper) is made by controlling the rate at which the part is immersed in (and withdrawn from) the chemical solution. Upon completion of the first cut (Fig 2) the exposed section is masked again and two other areas are each scribed, stripped and tapered (Fig 3).

After all three tapers are completed, the part is again remasked so that there are no exposed areas. The area of the deepest cut is then scribed, stripped and milled. Since each of the remaining five steps represents a shallower cut, no further masking is required. As each succeeding area is scribed and milled, additional metal is removed from the exposed sections in order to bring all six cuts to their final, specified depths at exactly the same moment. The finished part (Fig 4), with every section milled to exacting tolerances, is then ready for installation in the vehicle for which it was designed.

This is a graphic example of the design potential, which has been vastly broadened by USCM and its method of manufacture. A single integrally-stiffened part has replaced nine separate pieces, which had to be riveted, bonded or welded together to form a subassembly with structural weaknesses and higher manufacturing costs. (212)

Barrel finishing:

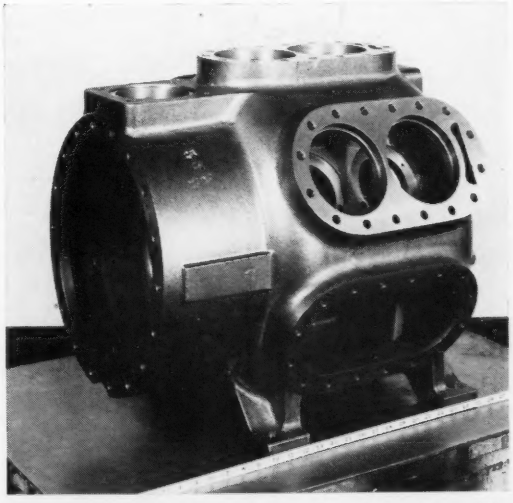
large parts can now be handled

As barrel finishing equipment and methods continue to advance, very large metal parts are being effectively deburred and finished.

For example, giant compressor housings (285 lb, 2½ ft along the base), are being deburred and polished in an Almco Model DBF-800-40-1 "fixture" machine, making substantial savings in time and cost over former manual finishing methods. After the barrel finishing process, gasket surfaces are completely burr-free, with low microinch finish. The inside of the housing is entirely clean, with all particles eliminated.

The fixture type of Almco barrel uses custom-designed fixtures to hold the large part securely during the work cycle, yet permits the abrasive action to reach all surfaces. Very intricated parts, with complex configurations, can be processed in such equipment.

The door-mounted fixtures are designed for easy removal with allied handling equipment. (213)



Sample large metal part after barrel finishing. The gasket surfaces are completely free of burred edges.

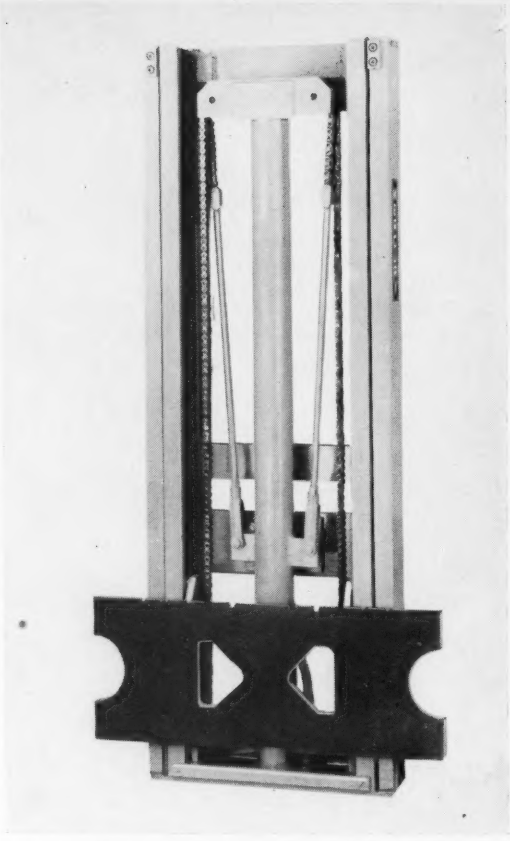
Fork truck: new mast assemblies

Two new series of mast assemblies have been introduced by Mercury Manufacturing Company for use on its fork trucks. Completely redesigned with uprights milled from solid stock, smaller rollers and other refinements of fine engineering, they offer lift truck users shorter turning radii and higher over-all lifting ranges, important factors in modern industrial handling.

The standard series of masts (the Duoscopic) have a 2:1 lift ratio and will be used on fork trucks of all capacities. The other mast series (the Triscopic) give a 3:1 lift ratio and provide greater free lift (before mast extension begins). Free lift is essential in operations involving loading and unloading through semi-trailer and railroad doors.

Both new masts are more compact than their predecessors. Channel uprights are milled from solid high-carbon steel bar stock, providing an assembly with full strength and rigidity in a narrower channel. The reduction in channel depth permits the use of smaller rollers which, in turn, helps increase over-all lifting height. The milled channels, further, eliminate the misalignment problems, rough surfaces and sloppy tolerances encountered in channels constructed by welding two steel angles together. Eccentrically adjustable rollers on lifting element and telescoping channel members compensate for any wear that might occur.

On the lifting element, floating side-thrust rollers (to maintain side clearances and handle lateral forces produced by off-centre loading) are easily adjusted by turning readily accessible set screws. (214)



A complete mast assembly, one of the two new series.

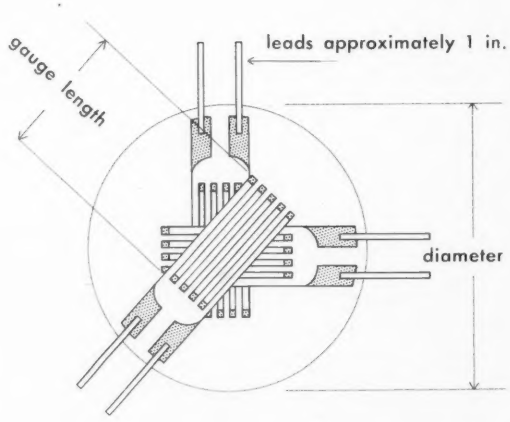
Strain gauge: high on sensitivity and stability

New SR-4 foil type rosette strain gauges with substantially higher sensitivity and stability than any previous rosette gauge have been announced by the Electronics and Instrumentation Division of Baldwin-Lima-Hamilton Corporation.

The gauges are of bonded filament type construction and they have a sensitivity 8% higher than that of any previous rosettes. They need no lateral corrections (except in the most precise testing problems), can withstand temperatures as high as 300 F in continuous service and are thinner, more flexible and more easily applied than bonded wire SR-4 strain gauges.

Two sizes of bakelite bonded rosettes are available:

Type	Resistance (Ohms)	Gage Factor (Approx.)	Gage Length (In.)	Diameter (In.)
FAP-4	120 ± 1.5	2	¼	—
FAB-4	120 ± 1.5	2	¼	—
FABR-2	120 ± 1.0	2	½	1 1/16
FABR-4	120 ± 1.5	2	¼	23/32



The new rosette consists of three single element foil gauges individually insulated and mounted in Bakelite.

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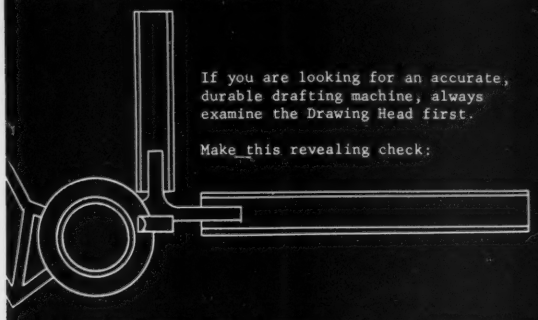

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(will be more accurate)

Screws secured in position by dowpins ..... ☐ YES ☐ no
(will hold accuracy for many years)

Metal surfaces chromed and sand-blasted .... ☐ YES ☐ no
(will stand up better than nickel and other finishes)

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YOU CAN'T FIX

a picture to a cobweb, of course, because the cobweb wouldn't hold — but if you could, you'd probably use a "RAWLNUT"* to do it with. "RAWLNUTS" are ideal for fixing in thin, hard, brittle or crumbly materials.

The "RAWLNUT" is a tough rubber sleeve, with a flange at one end and a bonded-in nut at the other. It is used with a standard machine screw. In thin material, the "RAWLNUT" mushrooms under the pressure of the tightening screw to form a rivet-like head behind the material. In thick material, it expands to grip the sides of the material with vise-like pressure.

If you've got an *awkward* fastening job to do, in plaster walls, thin wood panelling or glass, for example, "RAWLNUTS" are what you need.

"RAWLNUTS" are vibration-proof, waterproof, electrically insulated, air-tight.

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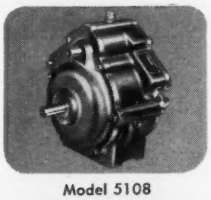
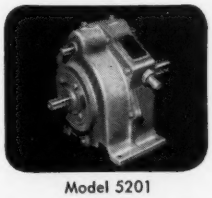
Smooth Power

S-N 4 IN 1 REVERSING TRANSMISSIONS



Model 5108



Model 5201

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Transmission Engineers
FOR OVER HALF A CENTURY
INDUSTRIAL DIVISION
THE SNOW-NABSTEDT GEAR CORP. HAMDEN, CONN.

Types FABR-2 and FABR-4, with gauge lengths of ½ in. and ¼ in. respectively. The former replaces the epoxy-backed rosette Type FAR-2, the foil gauge formerly offered, whilst FABR-4 is an entirely new product.

The bonded-wire type rosette gauges most nearly comparable to the new foil gauges are the paper-and-cement types AR-1 and AR-7. The new foil rosettes are so superior in dimensions (and in many other respects) that the foil gauge will probably supplant the wire gauge entirely.

These bakelite foil gauge rosettes extend greatly the usefulness of the rosette as a stress analysis tool. In addition to pin-pointing the area under consideration to a ½ in. or ¼ in. circle, the bakelite and glass fibre filler construction results in greater stability than previously achieved both as regards moisture and aging.

The gauges can be applied using either conventional bakelite (furnished with them) or epoxy-type cements, such as Armstrong A-2. The epoxy cements are very easy to use, because heat and high clamping pressure are not required. The upper limit of temperature for bakelite cement is 300 F in continuous service (400 F for short tests), while the epoxies are limited to below 180 F for accurate strain measurements.

The greatest possible error due to ignoring lateral corrections, with these new gauges, is 1% compared with 3% for wire-gauge rosettes. Their thickness runs from 0.004 to 0.006 in., compared with the thickness range of 0.007 to 0.009 in. for similar wire gauges.

In addition to the two rosettes, the Division is offering two other new, single-element foil gauges in a program which will soon make available types of the superior foil gauges equivalent to each existing SR-4 bonded wire strain gauge.

Dimensional and electrical specifications for the four new SR-4 foil gauges are given in the table. (215)

Soldering aluminum: some simple new techniques

Simple and effective techniques for soldering aluminum and its alloys (as well as galvanized metals) have been developed by G. M. Bouton and P. R. White, metallurgists at Bell Telephone Laboratories. These techniques employ an inexpensive and stable zinc base alloy as a preferred solder, and no flux or vigorous abrasion is necessary. Joints in aluminum made by these methods are stronger than commercial aluminum itself.

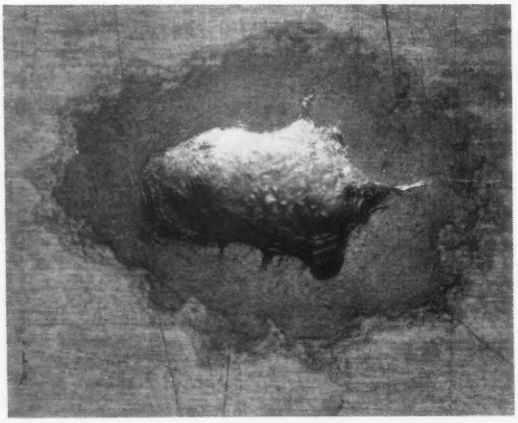
Because of their simplicity, the techniques are expected to find widespread applications both in industry and in the home workshop. They are most effective for the types of joint (such as butt and T) where the surfaces are accessible for manipulation with the solder stick.

Long-term stability of the soldered joint is assured by the rigid exclusion from the high purity zinc base alloy of deleterious elements such as lead, tin, bismuth and cadmium, which cause intergranular corrosion. A fraction of magnesium may be added to enhance its stability, and up to several percent of aluminum may be included.

In soldering aluminum it is not necessary to remove rolling mill oils or the surface oxide from the area to be wetted. A single stroke of the solder stick across the heated aluminum surface causes the solder to penetrate the oxide and wet the aluminum. The normally tenacious oxide film is lifted off, much like paint peeling from wet wood. This raised oxide coating may then be wiped aside.

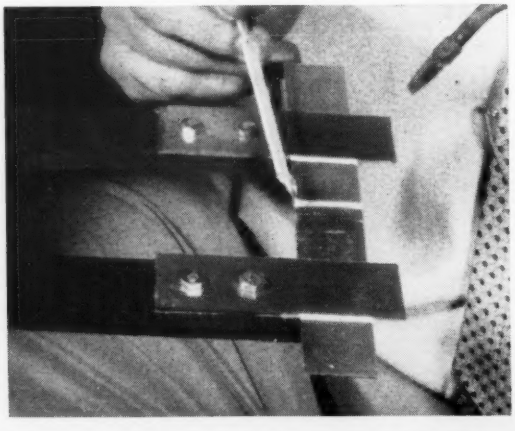
Surfaces thus wet can be joined by bringing them together and adding more solder by drawing the solder stick across the hot metal pieces. Heat may be applied electrically or by means of torches burning common fuels.

This soldering technique is equally effective for joining galvanized surfaces without a flux. Joints produced by it are strong and stable. (216)



Spot of solder on a sheet of aluminum. Dark area is where the solder has crept under the oxidised layer.

Demonstration of the new aluminum soldering process.



Continued on page 52

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MINIATURE PRECISION BEARINGS

Electrical contacts: a new line in powered metals

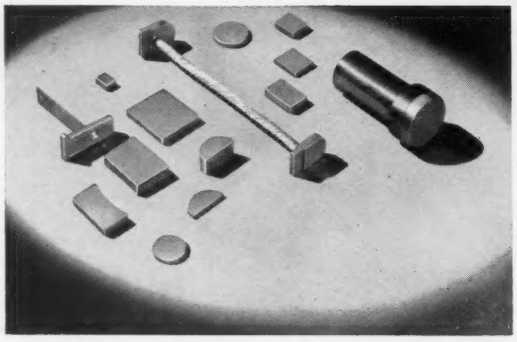
An expanded line of silver-graphite powdered-metal electrical contacts has been developed by Gibson Electric Company.

Nine new materials have been added to the graphite Gibsiloy group, which now totals 15. Included are silver-graphite, silver-nickel-graphite, silver-tungsten-graphite and copper-graphite powdered-metal compositions.

According to Gibson engineers, the newly-expanded graphite line will allow greater flexibility in selecting and adapting the correct contract material to each electrical product. Typical uses include disconnect switches, light-duty air circuit breakers, rheostats, contact brushes and contactors.

Being non-metallic, graphite reduces the welding tendency of electrical contacts, improves the "surety of making contact" because it cannot tarnish or form surface oxides, and imparts self-lubricating properties. Graphite Gibsiloys are made from mixtures of metal powders and graphite powder. Because graphite tends to retard brazing, the contacts are specially treated to provide a surface satisfactory for brazing with silver solder.

New materials in the line are these graphites: C-6 for disconnect switches; C-2 for contactors and rheostats; C-1, C-500, C-250, C-125 for rheostats and contact brushes. Also new are NC-205 (silver-nickel-graphite) which is ideal for current-carrying hinged connections on circuit breakers and disconnect switches; CW-52 (silver-tungsten-graphite) for light-duty air circuit breakers and for rheostats; UC-7 (copper-graphite) for rheostats and contactors.

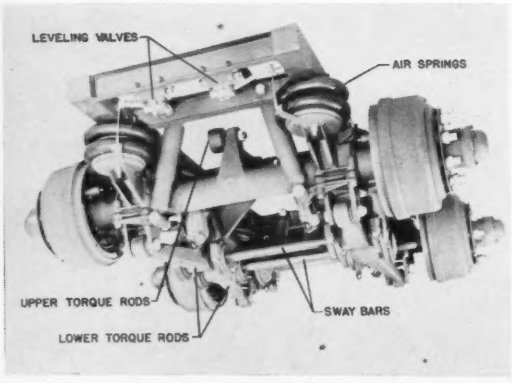


Sample selection of the new powdered metal contacts.

C-1, C-500, C-250, C-125 and UC-7 are recommended as sliding contacts only, while CW-52 is capable of use only as make-and-break contacts. C-6, C-2 and NC 205 may be used for both functions.

All graphite Gibsiloys are available solder-backed for brazing. The company supplies contacts alone, or assemblies. (217)

Air suspension: design for a level trailer bed



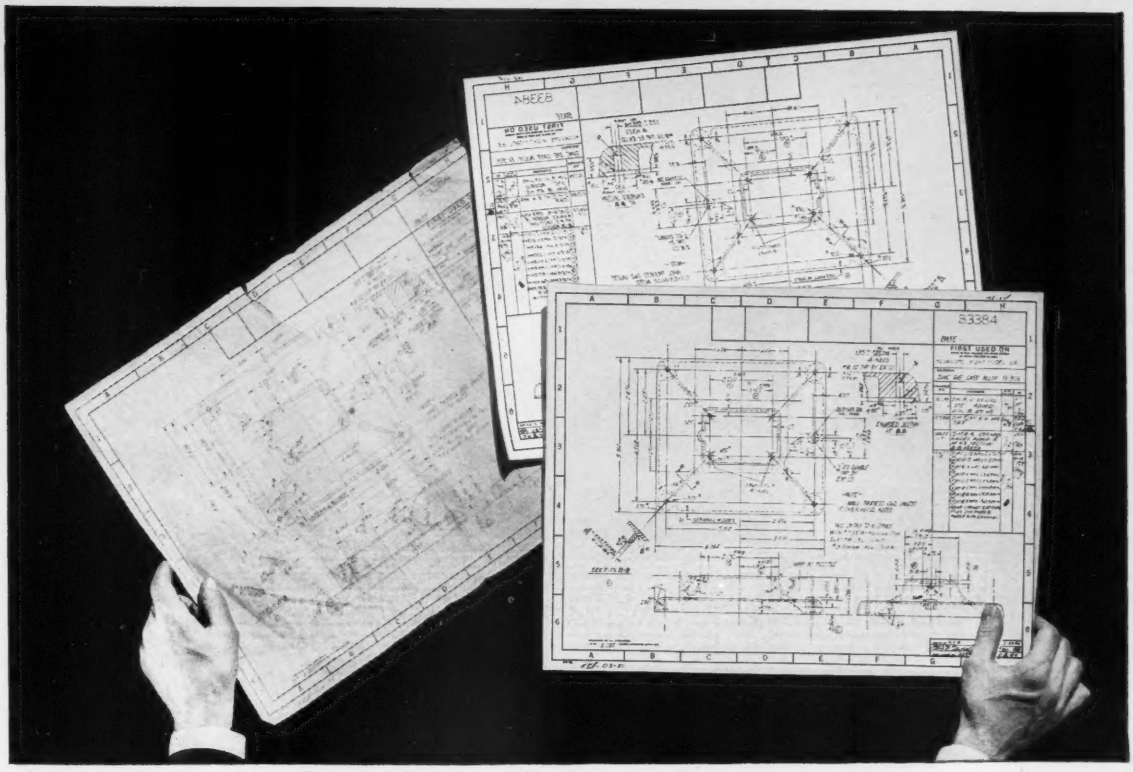
A semi-trailer air suspension system, featuring integrated air reservoirs and advanced sway control designs, has been introduced by Clarke Equipment Company's automotive division.

The units are available in single axle models of 18,000 and 20,000 lb capacities and tandem models of 32,000 and 36,000 lb capacities. Each is offered in packaged assemblies of frame, air springs, reservoirs, shock absorbers, filters, leveling valves and sway bars, for simple installation on new equipment or operating trailers. Interchangeability of parts between single and tandem models is provided to facilitate fleet maintenance.

Air reservoirs are integral parts of the unit. Air is delivered to each reservoir by a common line from the tractor's compressor. Each reservoir in turn serves one side of the air suspension independently of the other. Thus, (Clark engineers point out) the trailer bed remains level both laterally and vertically under all load conditions.

Built-in sway bars are provided to minimize lateral roll. Two lower torque arms and an upper torque rod maintain and position the axles laterally and absorb brake torque. (218)

Continued on page 54



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SOME OF THE TRACINGS your customers send in were probably "tired" from the start—have light, anemic lines incapable of turning out really readable prints. Others owe their lack of graphite to constant handling and use in print making.

To produce legible prints from such lacklustre originals is easier than it looks. Simply reproduce them on Kodagraph Autopositive Paper or Film, depending on their condition. It's amazing how these materials can step up line density . . . render even faint detail crisply and sharply.

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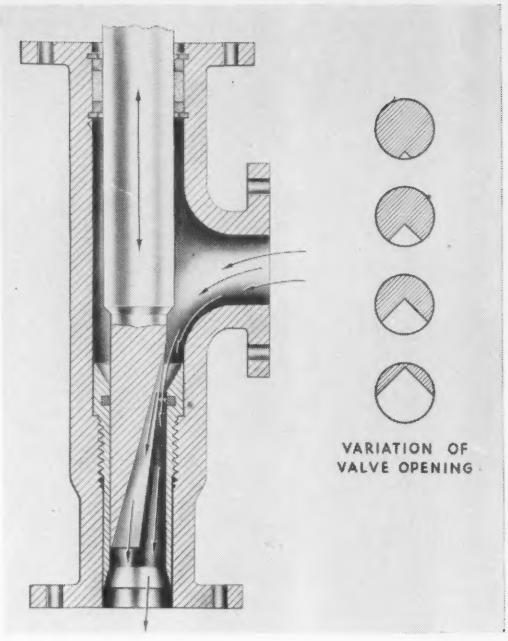
Valve: tapered orifice design

The tapered orifice valve made by General-American Valve Co. offers a radically new concept of flow control. By moving a plug with a tapered slot into (and out of) a circular opening, the flow of fluid or gas is controlled by the area of the tapered slot at the head of the opening. A circular sealing ring eliminates by-pass.

Replacing the needle valve in nearly all applications, the valve will pass foreign particles twenty times as large as will comparable needle valves.

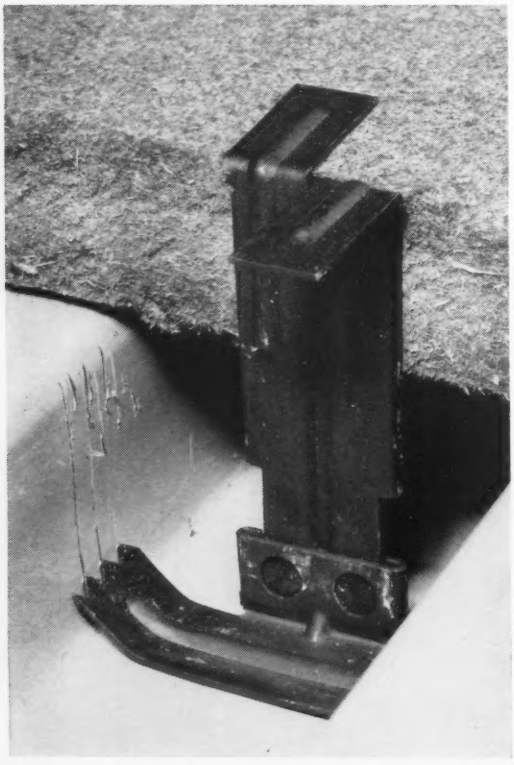
Its principal advantages are: it is a highly accurate, infinitely variable control: non-clogging; non-freezing, abrasion-resistant with an excellent coefficient of flow at all settings, with very low turbulence.

Thoroughly field tested, the tapered orifice valve is available in many sizes, pressure ranges and connections. Special design problems are welcomed and manufacturing licensing will be considered. (219)



The valve has an excellent flow under all conditions.

Fasteners: for attaching insulation to metal decks



Following successful experience since early 1956, a complete line of these fasteners is now manufactured.

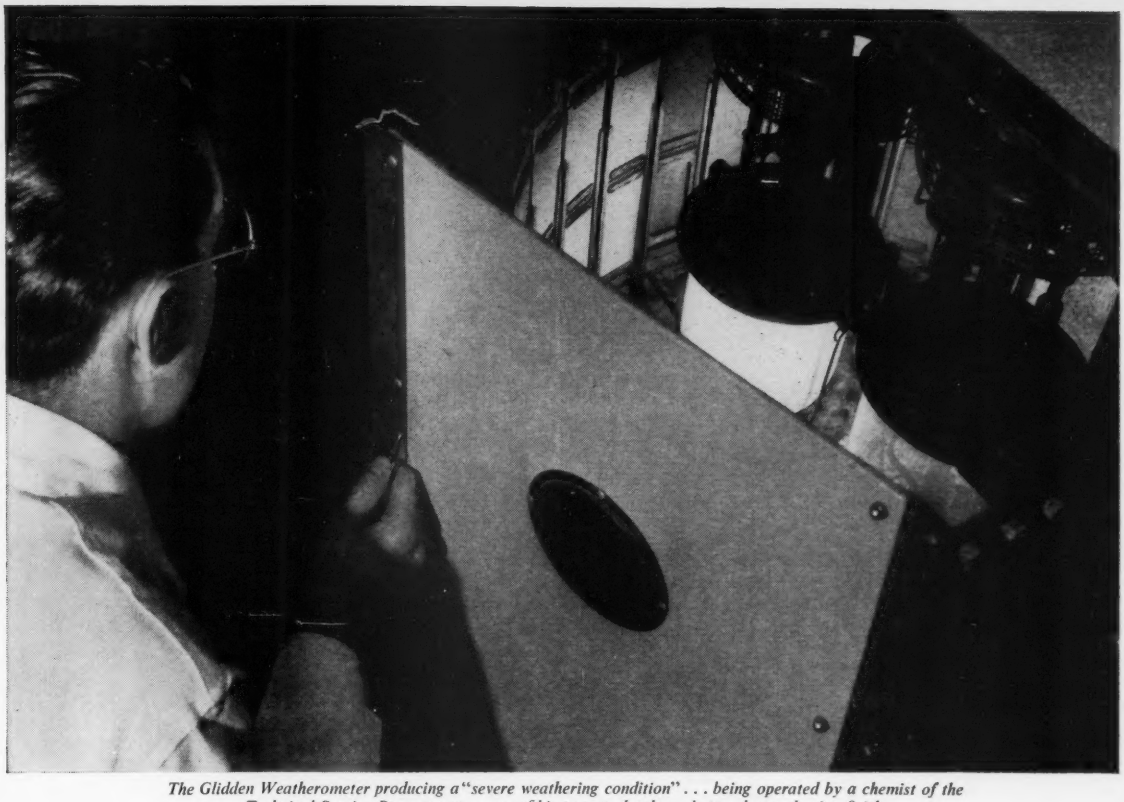
A complete line of non-piercing mechanical fasteners developed for attaching roof insulation to the various types of metal channel decks is being introduced by Geo. A. Tinnerman Corporation. This follows the use of one such clip to secure more than 1½ million sq ft of insulation under all extremes of weather since early 1956.

Originally developed by the Research Division of Dominion Fasteners Ltd. (at Hamilton, Ontario), the new fasteners (known as GAT-Dek clips) have been approved by accredited testing laboratories in Canada and the United States.

The system provides a first-class vapor barrier without the use of costly membranes. It has been used with just as much speed on installations within the Arctic Circle.

The clips themselves have sharp serrated teeth at each end of the foot element. These grip the sides of the deck flute when the clip itself is driven into place with a simple tool. The clip is snapped into the tool, which in turn is placed vertically against the edge of the insulation and driven into the flute of the deck by hammer blows on the head of the tool. The next section of insulation board is then butted against the board already in place, so the edge is snug against the upright leg of the last preceding fastener. Since the fastener has opposing tabs, one clip serves as a common anchor for two abutting boards.

The illustration shows a GAT Dek-Clip in place and the way in which the serrated teeth at each end of the foot element grip the sides of the flute after the clip has been seated. The section of insulation material is simply slipped under the projecting tab and butted against the board already in place. This clip resists a pull-out load in excess of 200 lb. (220)



The Glidden Weatherometer producing a "severe weathering condition" . . . being operated by a chemist of the Technical Service Department as one of his tests to develop a better, longer-lasting finish.

GLIDDEN CREATES THE WORLD'S WORST WEATHER . . . TO GIVE YOU LONGER-LASTING FINISHES

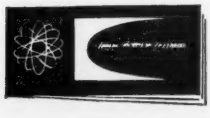
QUALITY Glidden PRODUCTS

To produce finishes that we can definitely say will last longer, stay brighter and resist weathering, we put them through many and varied tests—tests far beyond their normal requirements.

A typical example of this type of testing is carried out in the Weather-ometer. This is a machine that simulates heavier rains, stronger suns and more intensive heat than any finish would normally encounter. A machine that telescopes into days the effects of years of abusive service. This is just one of the many tests carried out in the Glidden Laboratory.

We agree with you when you say testing shouldn't end in a lab. On your production line or in actual field use, Glidden continues its proving programme. Whether your problem is the effects of dust, salt spray, chemical fumes, oil vapor, extreme changes in temperature or the abuse the public gives your products—Glidden research ensures you of complete satisfaction. We will work with you to develop a finish and then prove its economy on your production line and its effectiveness in actual use.

In the Glidden Technical Service Department, consisting of practical chemists and technologists, using the most modern equipment, we are prepared to apply their wide experience to your needs. This department and the service it offers is freely available to you. Please contact your Service Representative or write us direct.



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New Products

Temperature regulator
Designed to withstand the corrosive effect of certain fumes, gases, acids and chemicals, a new stainless steel temperature regulator is now offered by **Fulton Sylphon Division** of Robertshaw-Fulton Controls Company.

The new regulator (called the No. 11061-R) was developed mainly for use in chemical plants. Other applications are in plating rooms and in processes where ammonia vapors are present. It is also recommended for exposed locations.

In standard models of this control, the entire upperworks are of stainless steel. The company said it will supply valves (as well as upperworks) in stainless steel, for use in extremely corrosive situations. It is available in sizes from ¼ to 4 in., and for temperatures between 20 F and 455 F.

Similar in operation to other Fulton Sylphon regulators, it requires no external power source (such as compressed air, water or electricity) to function efficiently. A large stainless steel bellows used in the thermal unit provides accurate and sensitive control over temperature. and sensitive temperature control. (221)

Surface grinders
Providing an economical method of finishing a wide range of ferrous and nonferrous metals, alloys, plastics and ceramics, the British-made Wright table surface grinders are now available in this country through **Air Transport Equipment, Inc.**

The entire line (ranging in size from 8 to 20 in. diameter) is available with a variety of accessories. (222)

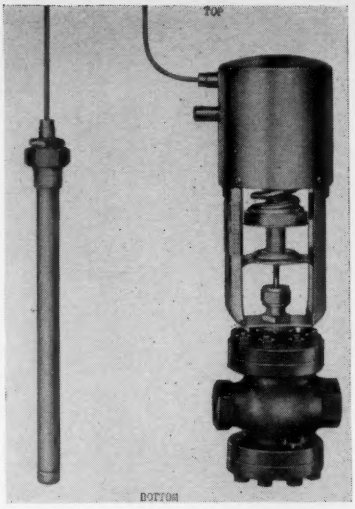
Air sampler
The problem of air pollution is of tremendous importance to municipal governments and industry, and **the Staplex Company** now has available a high volume air sampler unit for general use.

This unit was developed in the laboratories of the New York office of AEC and has been manufactured in large quantities.

The prime purpose of the unit is for sampling large volumes of air for particulate matter by means of a filter paper. The sampler has been used successfully to sample air containing particles as small in diameter as 1/100 micron.

The device employs a turbine type blower. It is designed for 24 hr sampling and has a rugged cast aluminum housing (to keep the weight down.)

A high volume air sampler has become quite a necessity in maintaining modern health standards, and many companies and municipalities are purchasing them for the wide and practical service they offer. (223)



Tough. (See 'Temperature regulators')


Does 24-hr duty. (See 'Air sampler')

Marine engine
A four page brochure, describing the recently developed Series 71E marine work boat engine, is available from **General Motors Diesel Limited.**

The brochure explains how the engine will give more profit for commercial marine operations: rated at 170 hp, it will save 10% in fuel. Five features of the new engine are illustrated in the text. (224)

Oil burning boilers
Planned as an aid to the designer, installer and operator of oil burning boilers, a manual (from **Cleveland Fuel Equipment Co.**) gives data, formulas and general information leading to improved performance and efficiency of the combustion system.

Each of the variable factors encountered in oil burning equipment is treated in a clear, easily understood manner. The importance of each step in the combustion process (as related to overall efficiency) is discussed in order of its appearance in the operation. (225)

Continued on page 58

Dust collectors

(Continued from page 35)

compounds, for cyclone separators precipitate the dust centrifugally and have no filters to clog. They have an unusually high collection efficiency for both coarse and fine particles.

Whirlwind motion

As the name implies, the cyclone separator operates by drawing the dust into the top of the filter's cone, where spiral baffles direct the air into a whirlwind motion. Dust particles are precipitated out of the air stream by centrifugal force and settle down through the cone to the dust reservoir below. With as much as 95% of the dust removed from the air in this way, the clean air is then drawn up through a squirrel-cage blower and exhausted.

These units handle from 260 to 5,000 cu. ft. per min.; two or more units are sometimes coupled together for greater capacity jobs.

The dust reservoir at the base of these machines has a pull-out drawer for neat and easy removal of accumulated dust.

Outdoor discharge

Cyclone separator collectors can be discharged to the outdors or (where it is desired to conserve heat) can be equipped with after-filters. One of these recirculating types uses an after-filter bag of woven wool. Another uses an after-filter constructed with disposable filter pads of glass wool. This second type is recommended for use where the nature of the dust makes it desirable to throw away and replace the filters.

Unusual application

A recent and unusual application of the cyclone separator principle is found in the diamond dust collector manufactured by Torit. This compact unit is used in conjunction with diamond wheel grinders. With typical cyclone action, it precipitates the diamond dust into a clear plastic container that can be visually inspected and quickly emptied when full. ★

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New products
continued

K-factor tester

Now available from **Tatnall Measuring Systems Company;** a K-factor tester to measure the specific thermal conductivity of a material.

This is a simple apparatus using the bag technique for heat conductivity measurements. It meets ASTM requirements, is quick and convenient tto use and low in cost.

It consists of a portable hot plate unit, a cold bath and a relay rack. The hot plate unit is a seven layer sandwich of plates held together by spring-loaded bolts. The unit and electrical connections are enclosed in a bag of thin plastic.

The two outside plates are metal coolant plates. The three central members form the heating part of the apparatus. Specimens up to 1.25 in. thick are held between the coolant plates and the heating section in the middle. Special models operating at temperatures up to 600 F can be furnished.

The cold bath comes in three models which operate at temperatures from room temperature down to —100 F.

The simplest of these uses water as the coolant. Another model uses a refrigerated mixture of water and glycol, while the third method (for temperatures down to —100 F) operates on a mixture of alcohol and solid carbon dioxide.

K-Factor measurement can be made with the Tatnall apparatus in from 2 to 6 hours, depending upon the specimens. Readings can be taken either from the recorder on the relay rack or from a potentiometer. (226)

Displacement pump

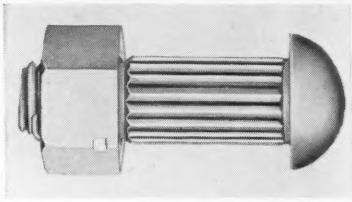
The Ejectopump is a compressed-air operated displacement pump that is completely pneumatic. It has no rotating or reciprocating parts. Regular intake and discharge strokes begin automatically when it is connected to any compressed air supply line. Because it is self-priming, the pump (unlike most compressed-air operated pumps) can be installed above the level of the liquid to be pumped.

The pump (which is handled in Canada by **Ferro Enamels (Canada) Ltd.)** consists of a cylindrical casing, a float and two non-return valves, which are in contact with the liquid. A header mounted above the casing is never in contact with the pumped liquid. It houses the pneumatic valves and an air-operated injector which operates only during the intake stroke. Rate of air admission to the casing during the discharge stroke is adjustable, allowing perfect control over the rate of discharge of the pump.

The B4 and B4 SV pumps have been designed to meet the special needs of users in the food and chemical industries where thorough, easy cleaning of all plant is required. (227)

Nut and bolt assembly

There is an easier way to secure steel beams. In use for many years in the U. S. and other countries, the Anco-Nut and structural Rib Bolt **(W. R. Watkins & Co. Ltd.)** are fast replacing the usual hot riveting system of joining used in steel construction here in Canada. This combination of rib bolt and lock-nut



forms an economical substitute for riveting both in cost of material and in labor. The contractor can erect two or three beams instead of waiting for an entire floor, because he does not have to bring out a four-man gang, heating furnace, air compressor and other equipment each time. (228)

Epoxies

Four new additions to the Hysol 6900 epoxy casting product series have been announced by **Houghton Laboratories Inc.**

This series (specially designed for the casting of transformers, coils, magnetic amplifiers and other similar equipment), incorporates longer pot life, low viscosity and the elimination of settling. Thus, a new ease of handling is attained, and these products are more suitable for continuous production techniques. The non-settling feature reduces the problems encountered in storage and preparation. Another advantage is their flexibility, which prevents cracking caused by temperature cycling and shock, often called for by Mil-T-27A. (229)

Deviation recorder

A speed deviation recorder with an accuracy of 0.1% has been announced by **Canadian General Electric Company Limited.**

The Type HE round chart recorder is designed for use in processes where it is necessary to maintain constant speed. An example is in the manufacture of nylon (or other man-made fibres) with similar applications in the steel, rubber, paper and chemical industries.

The instrument indicates and records the percentage deviation from a predetermined but adjustable speed. The input signal is received from a precision d-c tachometer generator and compared with a stable adjustable d-c reference. (230)

Ceramoplastics

(Continued from page 43)

Molded-in inserts are most desirable for high voltage, high altitude applications, because they reduce the possibility of corona forming in the gap between insert and insulator. With the matching thermal expansion co-efficients of the ceramoplastics and metals, it is possible to mold inserts that are totally corona-free under all thermal and altitude conditions.

Fig. 3 shows a switch assembly that makes interesting use of stamped contacts assembled at low cost in Mycalex 410 glass-bonded mica. The very narrow slots (0.018 in.) permit entry of thin metal stampings and can be molded with a very high degree of location and dimensional precision in the ceramoplastic materials. Steatite is sometimes used for similar applications, but it has a large substantial dimensional variable that calls for hand gauging before assembly, and may also result in a high spoilage factor due to breakage during assembly and riveting operations.

While the impact strength of the ceramoplastic materials are comparable to that of general-purpose phenolic, it may be low for some of the high vibration and high shock applications, unless metal reinforcement is added to gain high strength sections. Components making use of the ceramoplastic materials reinforced with molded-in steel inserts have passed the U. S. Navy's 400 lb drop hammer test, equivalent to a 20,000-ft drop.

Shown in Fig. 7 is a circuit-breaker, to illustrate a condition often met in relay design. The thin wall of the housing carries the entire shock of opening and closing the circuit breaker. Under very severe operating conditions, this impact could cause the case to break. The use of a simple metal screen stamping (which becomes anchored permanently to the surface during the molding operation), distributes the force over the entire area. Such reinforcement is only possible with materials having substantially similar thermal expansion coefficients. ★

Abstracts

Forgeability

While many metals and alloys can be readily transformed from a billet or bar section into an intricate shape by forging (with either open or closed dies) other alloys present great difficulties even in such simple operations as upsetting. In addition, the performance of a material during forging may vary greatly, depending upon differences in chemical composition, grain size and surface condition.

Many attempts have been made to compare the forgeability of certain types of alloys. However, the wide variety of forged shapes (and the fundamental differences between the alternative procedures by which a particular part can be forged) make it very difficult to define or measure "forgeability." The present survey of literature and of established commercial practices indicates a pronounced lack of agreement in this respect. (from ASTM Bulletin, July 1957, by Alan B. Draper).

Flame hardening

The versatility of the process was demonstrated recently on a large production order at Canadian Steel Foundries Ltd., in Montreal, Que. As part of this company's expanding operations, they are now casting their own friction shoes, important component parts of the ride control trucks on railroad rolling stock. This friction shoe is the first of ten similar types which Canadian Steel Foundries expects to cast regularly in the future. In service, the face of the shoe rides against a wear plate on the railroad car truck to absorb excess spring action and thus minimize humping. These shoes have proved superior to older style snubbing devices and this is the first time they have been made in Canada. Previously, they were imported from the U. S. where the required hard wearing surface on the face was achieved by induction hardening. (The high volume of U. S. production justified the large capital expenditure involved for the induction hardening equipment.)

Since Canadian production requirements do not begin to approach their American counterpart, Canadian Steel Foundries sought some more economical means to harden the friction shoe faces. Flame hardening was the logical answer. This oxy-acetylene process provides the high degree of surface hardness required, while leaving the core of the friction shoe in its original ductile state. The cost of the equipment required is trifling, compared to an estimated $150,000 for induction hardening equipment.
(from Liquid Air Review, June 1957)

Ringing signals

In a large business office (or in other situations where two or more telephones are in the same room) it is a great convenience if each telephone has its own distinctive ringing signals. In this way the user can recognize his telephone, even when he is away from his desk and other telephones are ringing at the same time. By the use of different metals of varying thicknesses, engineers have developed a series of gongs to provide up to seven distinct ringing signals.
(from Bell Laboratories Record, September 1957 by R. T. Jenkins)

Steel I-beams

Brittle failures in welded joints and riveted structures (such as in Liberty ships during World War II) are still only partly understood. In 1952, the National Research Council and the Canadian Institute of Steel Construction (CISC) sponsored a series of fatigue flexure tests on mild steels. In a research bulletin "Fatigue Life of Steel I-Beams" by J. Dubuc, Dr. T. A. Monti and Dr. George Welter (published by the CISC), the testing apparatus is described and the behaviour of each type of beam under test is related. Finally, results and conclusions from the tests are recorded.

Welded Tapered Girders (Canadian Institute of Steel Construction, Inc.). Design details are given in this well-produced booklet that will be of interest to structural engineers.

Voltage regulators

An engineering paper on corona type voltage regulators is available from **The Victoreen Instrument Company.** The paper describes how corona regulators can solve voltage regulation problems without the use of multi-tube circuits and so forth. It is illustrated with performance curves, graphic analysis of corona regulator operation and gives typical schematic diagrams for use in cascade regulators, circuits for increasing current rating, cathode follower regutor circuit and other applications.

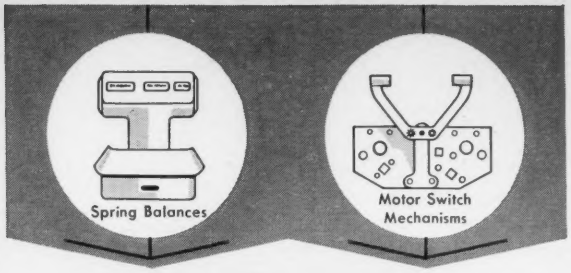
Welding

Publicly demonstrated for the first time in Canada at the recent Industrial Tool and Production Show in Toronto, the following literature is now available on Unionarc Welding **(Linde Air Products Company).**

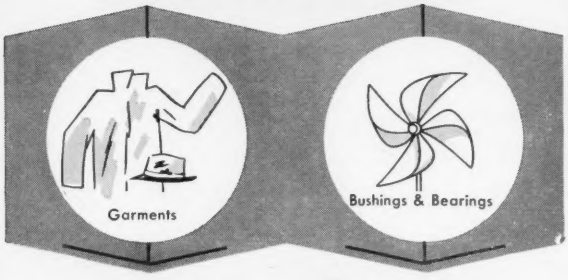
(1) A Better Way to Weld Steel. (Catalogue F-1060). Results of production-line tests are presented in this brochure.

(2) New Continuous-Feed Arc Welding. (Bulletin F-1076).

(3) Unionarc Welding Process. (Booklet F-1066). This article describes the weld quality obtained from the process.



Production



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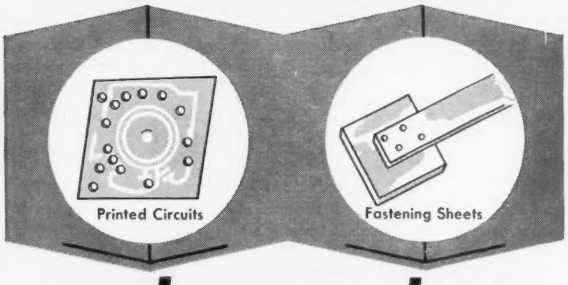

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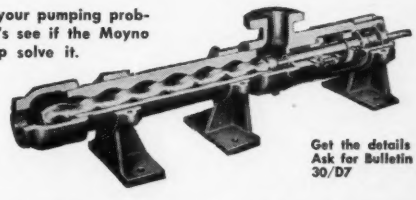
Perhaps, like the chow mein producer, you need to handle materials smoothly, without squeezing. The answer is *progressive cavities* — found only in the Moyno. If your *materials moving costs* seem high — If you have a pumping problem — or if you're wondering whether the Moyno is adaptable to your product, write us today! Ask for a free copy of Bulletin 30/D7.

By the way, with reference to the chow mein application, ladling proved to be too slow and expensive. Ordinary pumps made soup out of the celery. Moynos work perfectly, cost ⅓ less!

Tell us your pumping problem; let's see if the Moyno can help solve it.



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Editorial

Do you think you can read?

Ability to read fast is a skill that we could all add to our assets. Reading is just that; it is an acquired skill. Engineers, surprisingly, are poor readers, seldom have this skill and yet need it more than most men. They are slow readers because their training has emphasized attention to detail in reading above all else.

The last time you had any reading training you were probably a nine-year-old child and, unless you have studied reading since then, there has been little improvement in your speed since.

Statistically, 15% of adults have made no improvement since the 5th grade; 50% read no better than 6th or 7th grade students. In the testing of a mixed group in the U. S., a housewife and a 7th grade student beat every engineer in the group.

On average, an engineer reads at 200-300 words per minute—no better than a normal male with considerably less education. With 60-80% comprehension he could double this speed with ease.

Many companies are seriously disturbed by this gap in a man's abilities and, with a device called a tachistoscope, training film and reading pacer, are out to make some improvements. Heaven knows, they are needed, and there should be few things in business and industry that are more basic than the ability to read. A **really** interested man can increase his reading rate to 2,000 wpm and a few people can absorb printed matter at as high as 6,000 wpm without sacrifice of comprehension.

A reader must first realize that the eye does not flow, it flickers, and can see only when it pauses. 100% comprehension is not necessarily good or even obtainable. Slowing does not always improve comprehension and may even affect it adversely. Ability to change pace is important too. The average reader steams steadily through—the good reader adjusts his speed to the difficulty of the material. Like any other acquired skill, practice is the keyword.

How much time per day does an engineer spend with his eyes traveling a printed page? Three hours? If he could only **read** he could, in effect, add another hour and a half to the working day's span.

William Morse.

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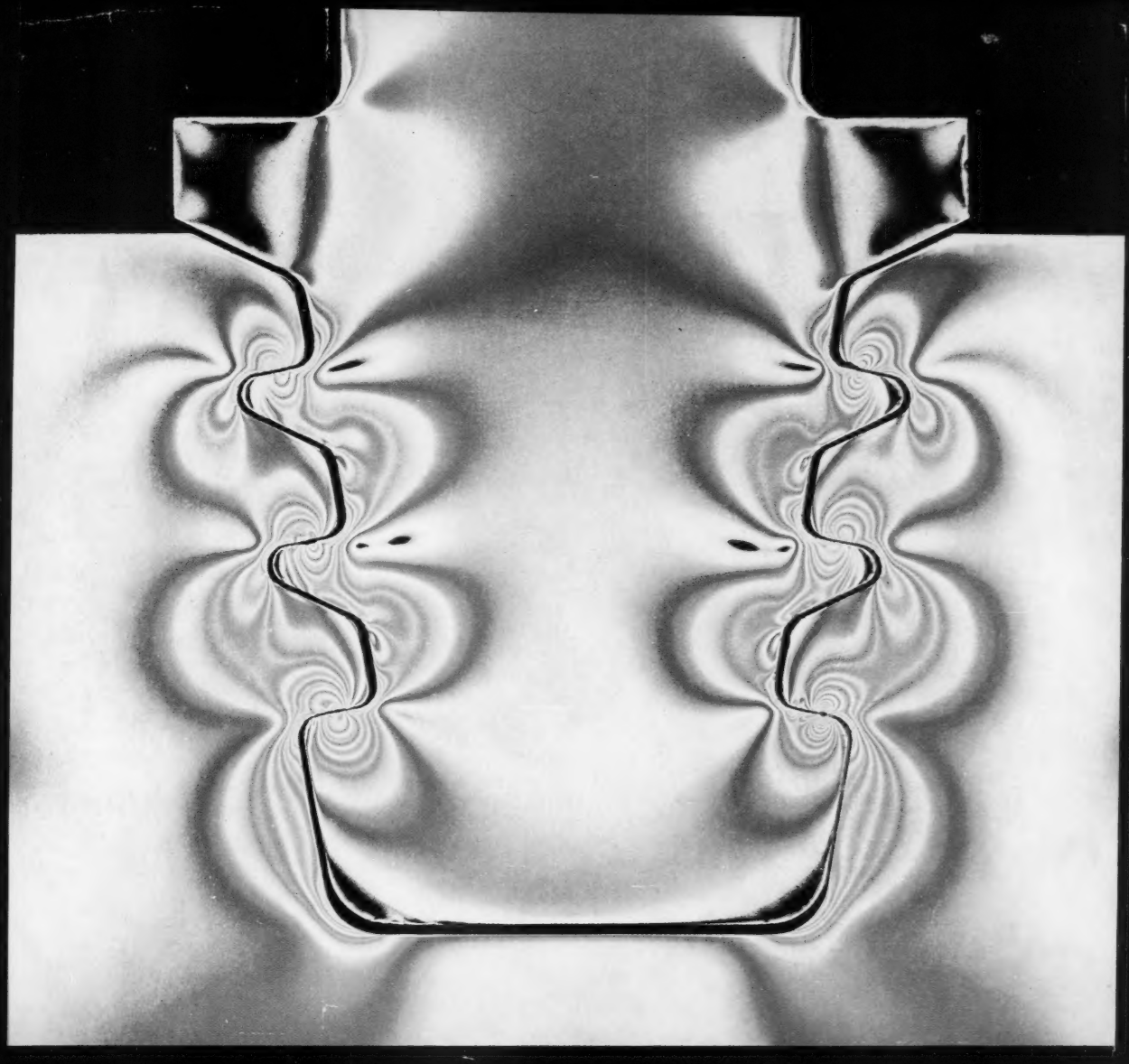

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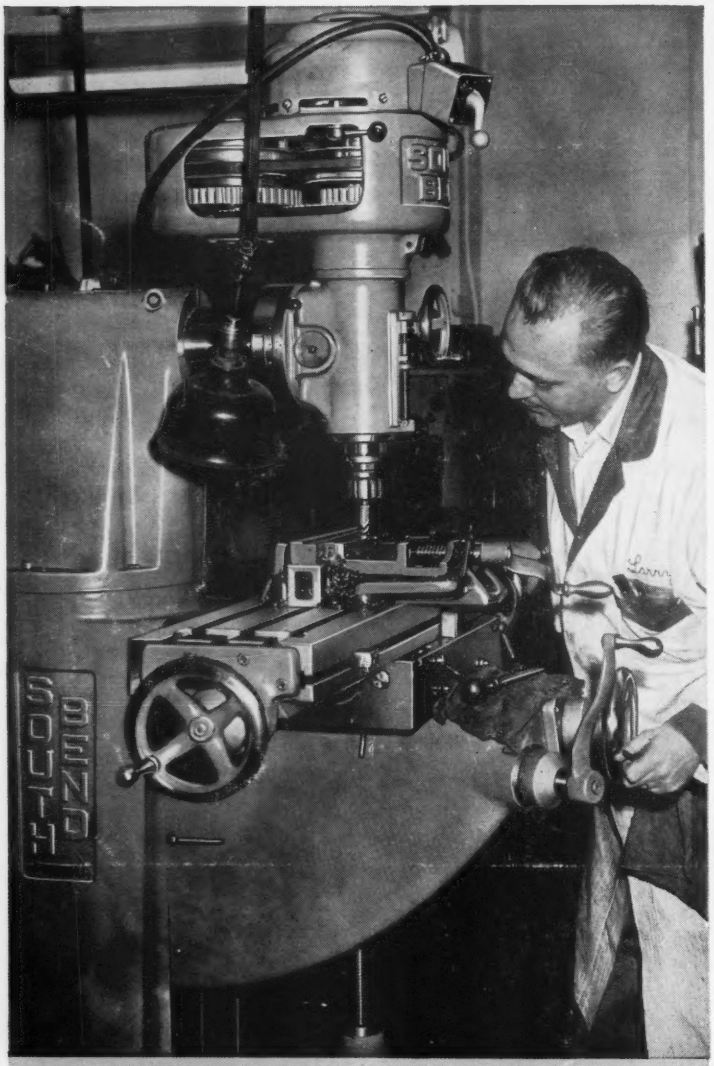

SOUTH BEND LATHE WORKS mounts the adjustable spindle of their vertical precision milling machine on two Timken tapered roller bearings to give it extra accuracy in any position. They also use Timken bearings in the elevating screw mechanism.

AT all eight speeds and at any angle, this vertical milling machine mills, drills and bores to fine tolerances. And to give the spindle extra precision in every position, South Bend Lathe Works mounts it on two Timken tapered roller bearings. These Timken bearings:

HOLD THE SPINDLE RIGID AT ANY ANGLE. Regardless of operating position and work loads, Timken bearings keep the spindle in positive alignment. Their tapered design lets them take *both* radial and thrust loads in any combination.

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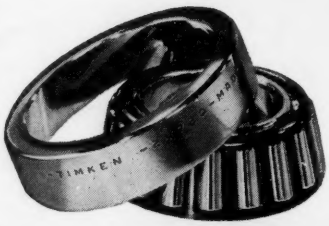

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